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MAY 1949

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(Chart VII, Snowfall, omitted until November.)

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CORRECTIONS

Monthly Weather Review, February 1949, vol. 77, Page 36, figure 4(b). The first equation in the diagram should read

$$\frac{H_{sb}^{sm}+H_{sw}^{sm}}{2} \text{ instead of } H_{sb}^{sm}+H_{sw}^{sm}.$$

Page 37, column 1: The symbol for the relative humidity at Santa Maria should read RH_{sm}^{7-pm} instead of RH_{sm}^{7-pm}, and for the wind direction at Bakersfield should read WD_{sp}^{sm} rather than WD_{sp}^{7-pm}.

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AN OBJECTIVE METHOD OF FORECASTING WINTER RAIN FOR PORTLAND, OREGON

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Manuscript received October 15, 1948

INTRODUCTION

This paper reports results of a study made for the purpose of developing an objective method for forecasting winter rain at Portland, Oregon, 24–48 hours in advance. The study was undertaken simultaneously with a similar investigation by Vernon [1] on forecasting rain at San Francisco. It was inspired largely by the need for improved forecasts extending beyond 24 hours for use in operational planning by agriculture, industry, and transportation. This method of forecasting is not a substitute for present forecasting techniques or thorough analyses of the physical processes of the atmosphere, but if used in conjunction with these it can be a valuable forecasting aid. These results should be used cautiously until more cases have been studied in order to find those variables which will produce the highest degree of forecasting skill.

Previous studies attacking the problem of forecasting rain on the west coast resorted to map typing, and the method of forecasting set forth in this paper also depends on proper typing of maps. Reed [2] was the first to publish a map typing system for the northeast Pacific Ocean, and in a sense it is the parent of those which followed. His system was based on the direction of the principal air currents over the northeast Pacific and each map was classified as N, NW, W, SW, S, or E, following in general the principles set forth by Abercromby [3] who earlier had developed a method of typing maps in the north Atlantic Ocean. Reed's system is descriptive and requires the subjective impressions of forecasters; nevertheless it is an excellent system, and one that has been used regularly since it was published in 1932. Brown [4], in 1943, published a paper on rainfall forecasting for Los Angeles. He considered weather types which were modifications of Reed's types, and his method of forecasting is partly objective. In the same year the California Institute of Technology [5] published an elaborate and detailed system of classifying maps. This development was based largely on the configuration of the pressure field with the position and intensity of the Pacific High forming the keystone. Then in 1946, Thompson [6] developed an objective method of forecasting rain at Los Angeles 6–24 hours ahead. This paper differs from Thompson's in that it aims to forecast rain for Portland 24–48 hours in advance thus providing a more useful service in operational planning.

Typing weather maps by individual deduction results in differences of opinion since a vast number of maps are reasonably similar yet have significant differences which are not readily recognizable. It was the purpose of the investigation outlined here, in conjunction with Vernon's study, to type maps by numerical means as the first step of an objective method of forecasting rain. Accomplishing that, the second step was to find suitable pressure gradients or other variables which would separate the "rain" from the "no-rain" cases in each type.

The 1300 GMT maps of the Historical Weather Map series [7] for the ten months of January and February 1932, 1933, 1935, 1936, and 1938 formed the basis for this study. These 297 maps were selected because they represent days during wet and dry months and months with average winter rainfall. In addition they represent a variety of weather types. A "rain" day is defined as one on which a measurable amount of rain fell in the official gage in Portland between midnight and midnight of the following day—20 to 44 hours after map time. Traces counted as "rain" only if measurable rain fell on the day preceding or following the day for which the forecast was made. A few other winter months were used for test purposes and the results from 4 of these, December 1930 and 1933, and January and February 1937, appear in a later section. Although the study was confined to the months of January and February, equally good results have been obtained in December and the results outlined here should be restricted to the main part of the rainy season.

INVESTIGATION

CIRCULATION INDICES AND MAP CLASSES

The first step in the investigation was to measure the meridional and zonal circulation by means of pressure gradients on the theory that atmospheric currents follow established patterns and the principal flow patterns usually are persistent for long periods. The areas in which these measurements were made encompass a large pressure field and extend far upwind from the west coast. By applying synoptic experience certain geographical coordinates were

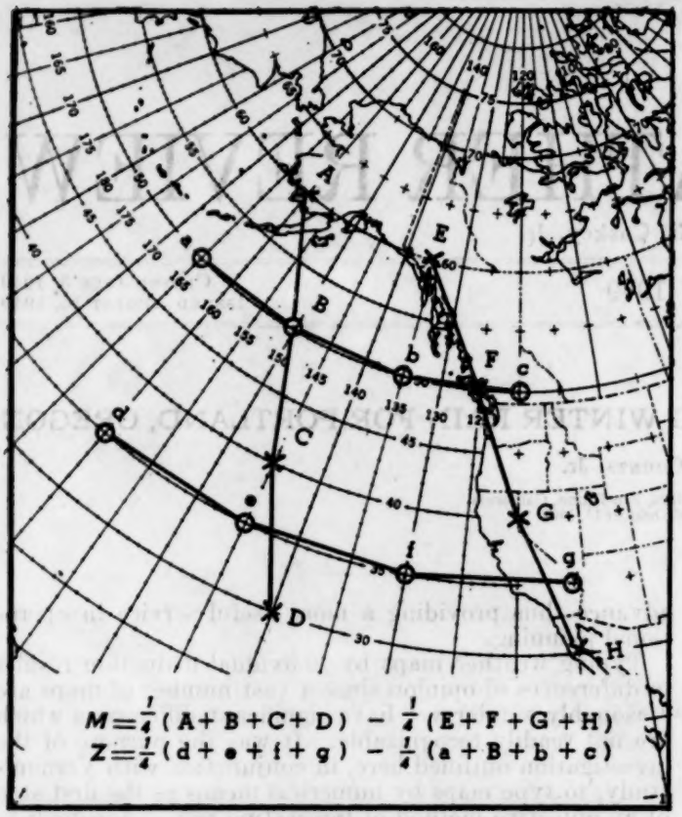

FIGURE 1.—Map showing location of points for which sea level pressures are obtained for computing meridional (M) and zonal (Z) indices.

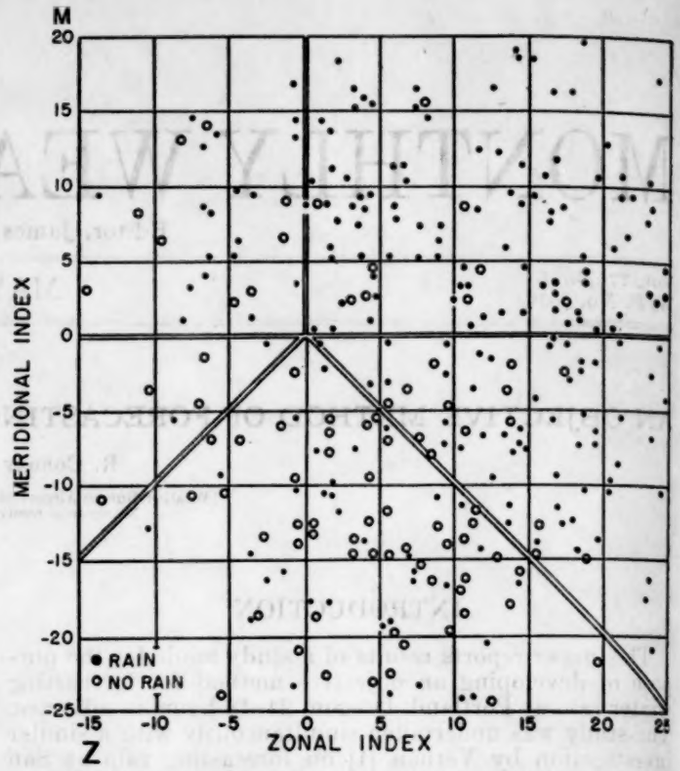

FIGURE 2.—Scatter diagram showing cases from original data of rain days and no-rain days plotted according to their respective meridional and zonal indices. The double lines divide the cases into 5 classes. (See fig. 3.)

selected in these areas which would define the several predominating flow patterns and the map types numerically. The coordinates selected for this purpose are shown on the map in figure 1. The difference between the means of the pressure at points ABCD and at EFGH gives an adequate index of the meridional flow (M). Expressed symbolically:

$$M=\tfrac{1}{4}(A+B+C+D)-\tfrac{1}{4}(E+F+G+H)$$

If this difference is positive the meridonal flow is from north to south but if the difference is negative the flow is towards the north.

The coordinates which are used to measure the zonal flow are indicated in figure 1 by points defg and points aBbc. The difference between the means of the pressures at the points along latitude 35° N. and latitude 50° N. gives a satisfactory index of the zonal circulation (Z):

$$Z=\tfrac{1}{4}(d+e+f+g)-\tfrac{1}{4}(a+B+b+c)$$

When this difference is positive the latitudinal flow is from west to east, and when negative, from east to west; the magnitude of the difference is an indication of the strength of the zonal circulation.

Algebraic relationships between the values of the meridional and zonal indices may be used to classify maps, numerically, into types. Abnormal circulation patterns such as "northerly" and "southerly" produce, respectively, positive and negative meridional values numerically larger than numerical values of the zonal indices. On the other hand a strong westerly circulation produces a positive zonal index much larger than the numerical value of the meridional index. Such relationships as these were used for classifying the surface weather maps examined in this study by plotting for each map a dot (rain day) or open circle (no-rain day) on rectangular coordinates

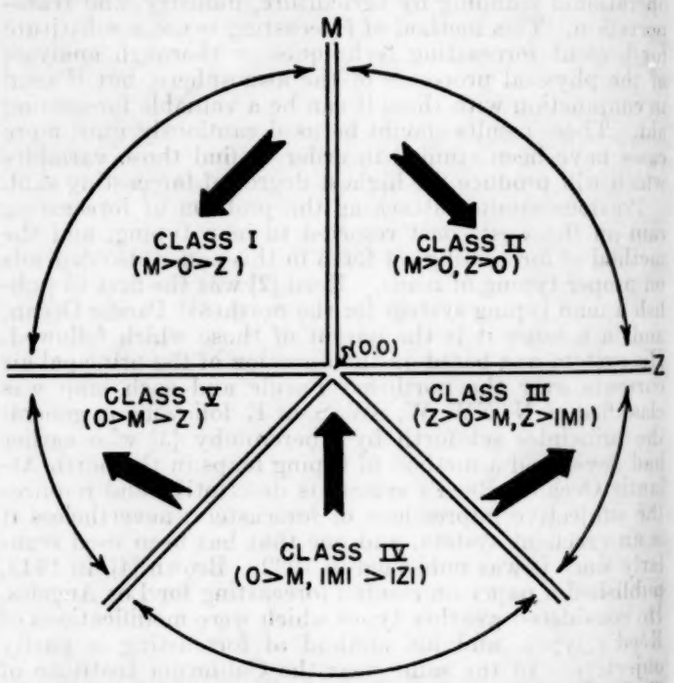

FIGURE 3.—Schematic diagram showing algebraic relationship between meridional and zonal indices for each of the 5 map classes. These divisions correspond to the divisions in figure 2. Heavy arrows indicate the predominant direction of flow over the area for which the indices were computed.

scaled for meridional (M) and zonal (Z) index values as shown in figure 2. Figure 2 then was divided by the double lines into 5 sectors in order to separate the plotted data into 5 map types or classes. As shown in figure 3, these 5 classes are defined by algebraic relationships between M and Z. The 297 maps used in this investigation thus were segregated as follows:

Class	Relationship between indices [1]	Number of maps	Rain days [2]	No-rain days
I	(M>0>Z)	28	19	9
II	(M>0, Z>0)	106	96	10
III	(Z>0>M, Z>/M/)	70	55	15
IV	(0>M, /M/>/Z/)	87	33	54
V	(M and Z<0, /Z/>/M/) or (0>M>Z)	6	2	4
	Total	297	205	92

[1] In these relationships, M and Z represent *algebraic* values. The symbols /M/ and /Z/ represent numerical or absolute values.
[2] There were almost 10 percent more rainy days in this sample than the average which, for this period, is 181 days of rain and 116 days of no rain.

The relationships between indices M and Z used for segregating maps into types differ from those used by Vernon in the cases with meridional indices greater than zero (M>0). Vernon separated this group of maps into three types: Northeasterly, Northerly, and Northwesterly, but in this paper these maps are separated into Class I (M>0>Z) and Class II (M>0, Z>0). To avoid confusion with Vernon's terminology, the word "class" rather than "type" is used.

The heavy arrows in figure 3 indicate for each class the general direction of the predominating air flow over the area for which the indices M and Z were computed. A few examples serve to make clear the relation of the index values to predominating flow. Points plotted in the upper left quadrant of figure 2 indicate "northeasterly" type maps on which meridional values are positive and zonal values negative (M>0>Z). Thus the map in figure 4 is not a pure "northerly" type but a map which contains features of both "northerly" and "easterly" types as indicated by the index values M=+4, and Z=−6. The map in figure 5 is an excellent example of a "northwesterly" type. For this map the index values are M=+11.5 and Z=+12.5, indicating a strong flow from the northwest. The map in figure 6 is a pronounced "southwesterly" type. The zonal flow is very strong (Z=+28), and the meridional flow is from south to north but rather weak (M=−4). Nearly all maps with large positive Z values and large positive M or small negative M values produced rain. A "southerly" type is shown in figure 7. The flow from south to north is strong (M=−13) while the zonal flow is very weak (Z=+1), indicating the westerly circulation is almost stagnant.

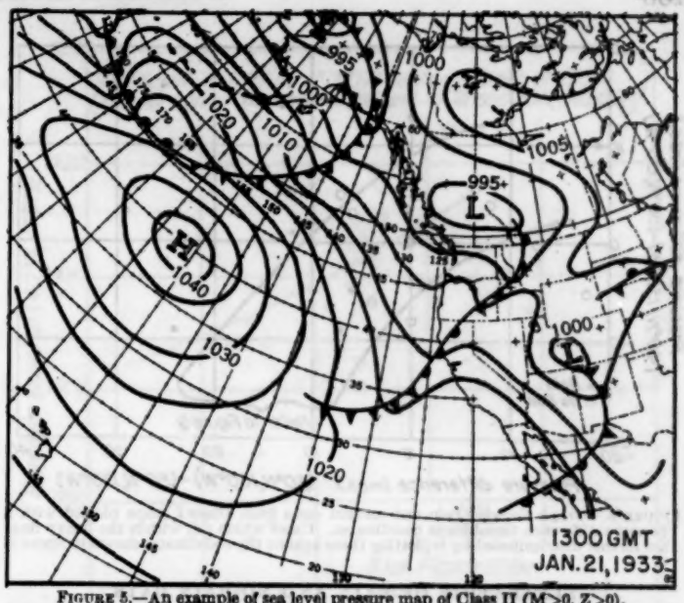

FIGURE 5.—An example of sea level pressure map of Class II (M>0, Z>0).

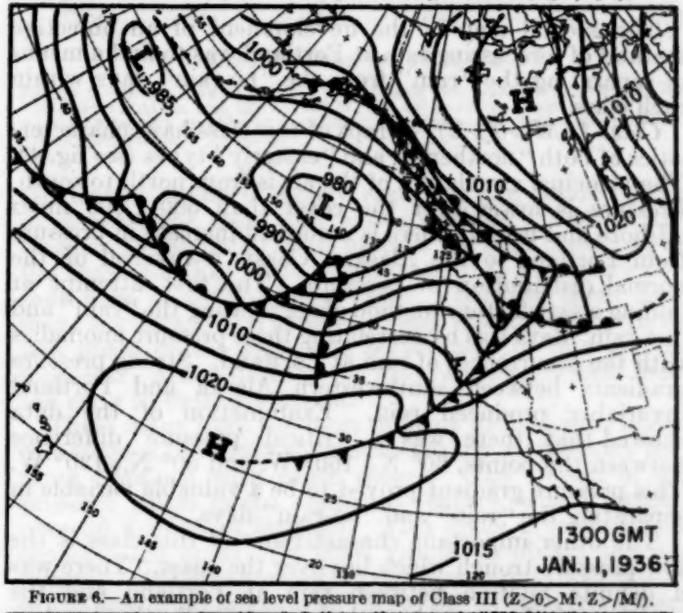

FIGURE 6.—An example of sea level pressure map of Class III (Z>0>M, Z>/M/).

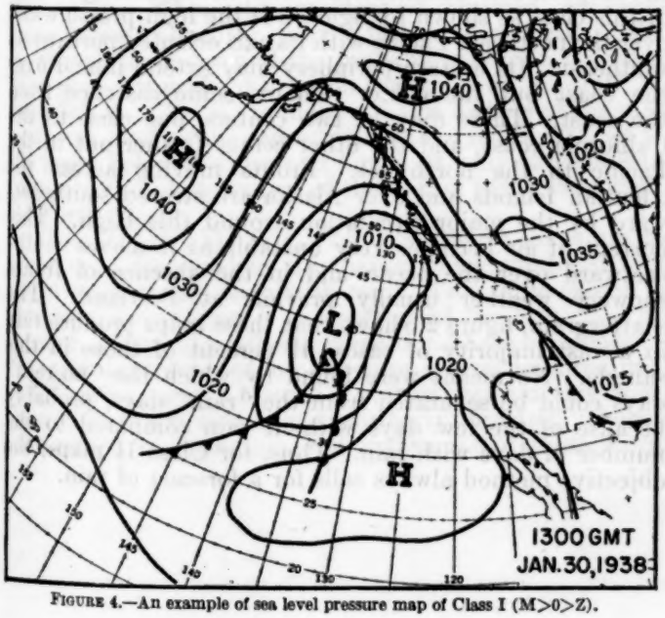

FIGURE 4.—An example of sea level pressure map of Class I (M>0>Z).

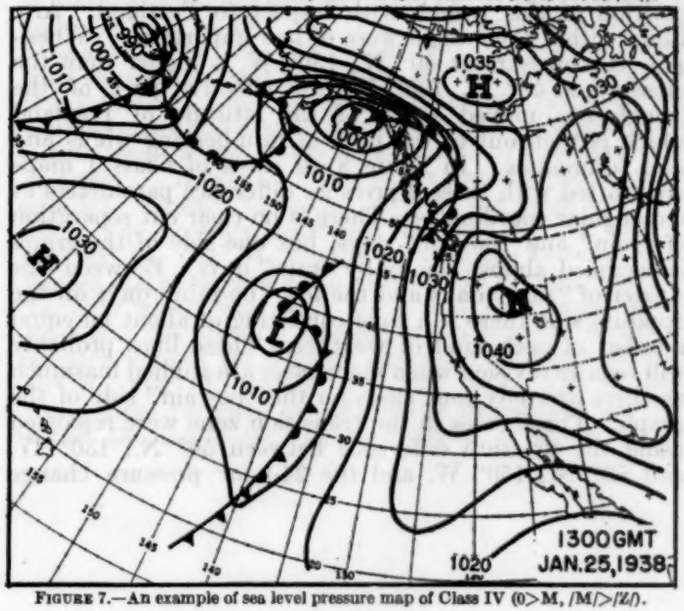

FIGURE 7.—An example of sea level pressure map of Class IV (0>M, /M/>/Z/).

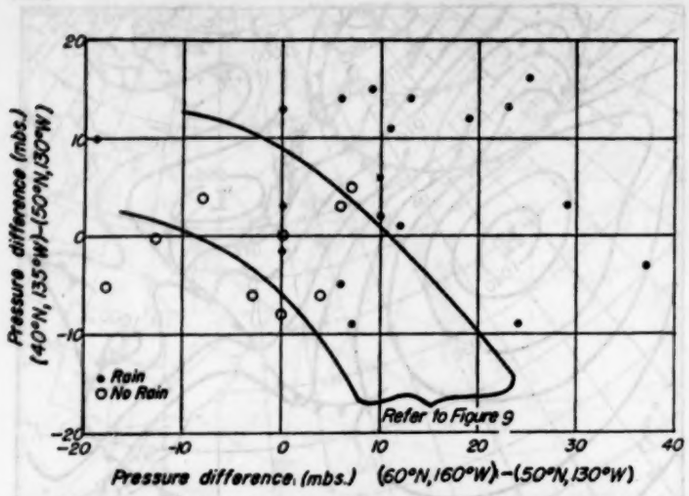

FIGURE 8.—Graph showing rain and no-rain cases from Class I maps plotted with 2 pressure difference variables as coordinates. Cases which fall within the heavy lines are further discriminated by replotting them against the coordinates shown in figure 9.

SEPARATION OF RAIN AND NO-RAIN DAYS

The second step in the development of an objective method of forecasting rain at Portland was to find a means of separating the "rain" from the "no-rain" days within each class.

Class I ($M>0>Z$).—Maps of this class have characteristics of both "northerly" and "easterly" types (see fig. 4). The principal circulation of the air is from north to south. Pressure is lower over the coast than 500–1,000 miles offshore and usually there is a marked increase in pressure from Portland to the Alaskan Coast, a reversal of the normal distribution of pressure. The first attempt at finding a satisfactory method of segregating the "rain" and "no-rain" days was by correlating these pressure anomalies with the occurrences of rain at Portland. Strong pressure gradients between southwestern Alaska and Portland invariably produced rain. Examination of the data showed that there was a critical pressure difference between the points, 60° N., 160° W. and 50° N., 130° W. This pressure gradient proved to be a valuable variable in separating the "rain" and "no-rain" days.

The other important characteristic of this class is the low pressure trough which lies over the coast. There was a definite relation between rain at Portland and the position of this trough with respect to Portland. Any Lows within the trough were of less importance. Whenever the pressure at 50° N., 130° W. is higher than the pressure at 40° N, 135° W. the effective part of the trough has moved south of the latitude of Portland which is then out of the path of rain-bearing winds and rain terminates. In figure 8 all cases of Class I maps are plotted with these 2 pressure difference parameters as rectangular coordinates. There is no clear cut separation of "rain" and "no-rain" days, but one side of the graph is occupied almost wholly by "rain" days. Between this cluster of "rain" days and the few "no-rain" days on the opposite side there is a zone consisting of about an equal number of each kind of weather. These lines probably will require revision when more cases are studied inasmuch as there are only four cases on the "no-rain" side of the graph. Those cases in the transition zone were replotted using the pressure difference between 50° N., 130° W. and 50° N., 150° W. and the 24-hour pressure change

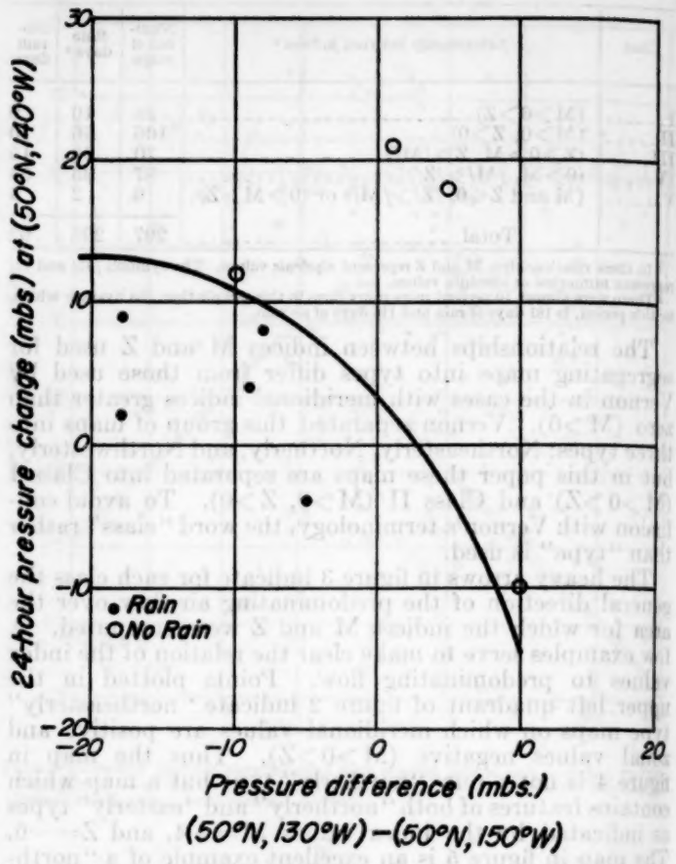

FIGURE 9.—Graph for use with cases which fall within the heavy lines of figure 8. These cases are here replotted against 2 secondary variables as coordinates.

at 50° N., 140° W. as coordinates (fig. 9). These two secondary variables further refine the characteristics of the low pressure trough and the high pressure ridge to the northwest. These variables should be used cautiously since there are too few cases to establish their validity.

Class II ($M>0$, $Z>0$).—This classification comprises the usual "northwesterly" types and a portion of those commonly called "northerly." The map in figure 5 borders between these two types but is representative of the maps in this classification. The distinguishing feature of this class as shown by figure 5 is the high pressure cell over the northeast Pacific with its axis oriented northwest-southeast. Its eastern periphery may extend inland over the coast but the center remains some distance from the coast. There may be two centers, one close to the California coast, and the other center farther out in the Pacific to the northwest. Fronts moving across the Aleutian Islands and over Alaska are steered southeastward by the major circulation around this High. This current of air becomes very unstable as it moves southeastward over the ocean and in the absence of fronts showery weather usually prevails at Portland. The scattergram, figure 2, shows that these maps produce rain in a vast majority of cases, 91 percent of those in this sample. No means were found by which the "no-rain" days could be separated from the "rain" days, probably because of the few days without rain compared to the number of days with rain. Thus, for Class II maps, the objective method always calls for a forecast of rain.

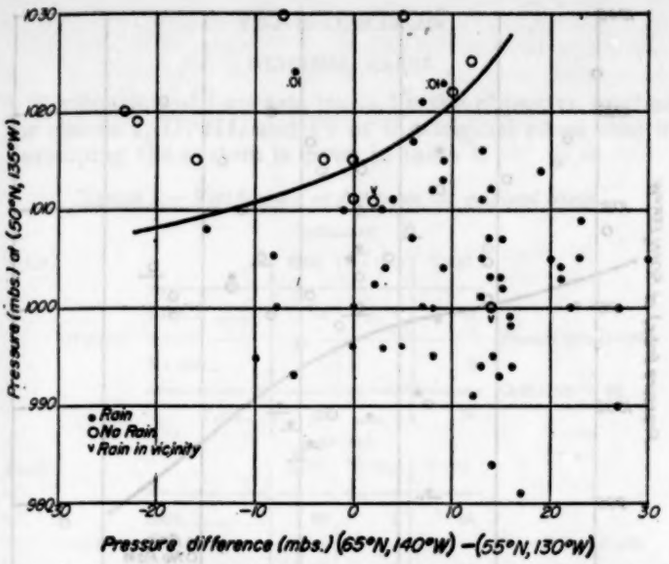

FIGURE 10.—Graph showing rain and no-rain cases from Class III maps plotted with 2 variables of the pressure field as coordinates.

Class III (Z>0>M, Z>/M/).—These are maps known as "southwesterly" types an example of which is shown in figure 6. There is a strong circulation from west to east with a weaker component toward the north. The High off the west coast usually shifts to the south or southwest just before the onset of rain. At times it merely weakens as another High appears farther west. There seemed to be a strong relationship between this High and the occurrence of rain at Portland but satisfactory results could not be obtained by using the location of the center of the High. The pressure along the northern edge of the High at the coordinate 50°N., 135°W., however, did give very good results. The pressure at this point was used as one of the coordinates in plotting cases for all maps of this class in figure 10. In the large sample rain occurred almost invariably whenever this pressure was near or lower than 1010 mbs. The effectiveness of the High off the coast in shielding Portland from rain is often offset by a High over northern Alaska. The probability of rain is greatly increased whenever there is a pressure gradient from central Alaska to the coast of British Columbia. When this gradient is reversed, southwest type Lows frequently recurve farther northward as they approach the coast and the probability of rain decreases. The pressure gradient between the points 65° N., 140° W. and 55° N., 130° W. brought out this feature of the maps and was used as the second variable in figure 10. Of the 56 cases below the curve in figure 10, only three failed to produce rain, but, in two of these, rain fell in the vicinity of Portland.

Class IV (0>M, /M/>/Z/).—Southerly maps are the only type discussed in this paper which produced more days without rain than with rain. To a large extent the pressure distribution is the reverse of the first class discussed. Typical southerly maps (fig. 7) are characterized by a broad trough of low pressure several hundred miles off the west coast. A series of storms begins in this trough and each storm moves in a northerly direction. During the period of formation and movement of these storms

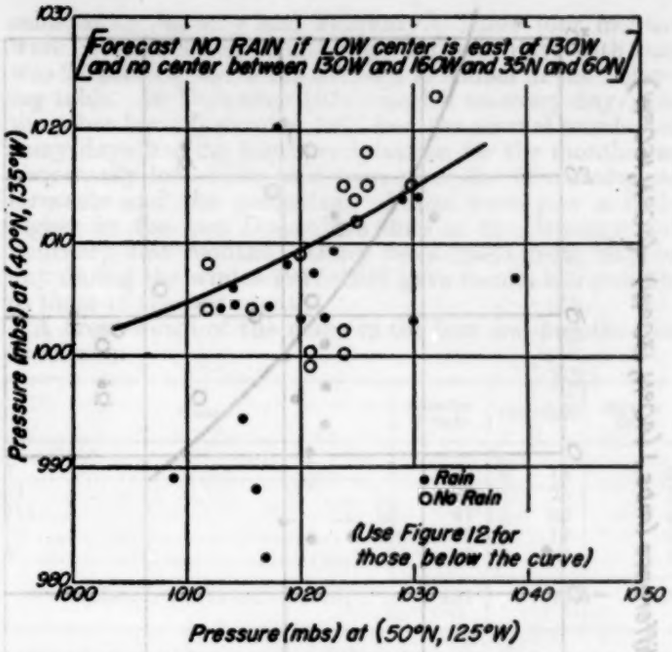
Forecast NO RAIN if LOW center is east of 130W and no center between 130W and 160W and 35N and 60N
Pressure (mbs) at (40°N, 135°W)
• Rain
○ No Rain
(Use Figure 12 for those below the curve)
Pressure (mbs) at (50°N, 125°W)

FIGURE 11.—Graph showing rain and no-rain cases from Class IV maps having lows centered within the area 130° to 150° W. and 30° to 45° N. These cases are plotted against 2 pressure variables as coordinates. See figure 12 for further stratification of cases which fall below the curve.

the trough advances slowly eastward and produces rain as it nears the coast and moves onshore. Another distinguishing feature of these maps is the high pressure over the coast and Far West in contrast to low pressure over that area in a "northerly" type. Because these Lows move northward and generally reach Portland only in the late phase of the type, the occurrences of rain are less frequent. Many times in the past rain was forecast much too early in these situations.

These maps were the most difficult to deal with and at this stage of the study the results are less satisfactory than those obtained with other classes. The trough of low pressure which is the dominant feature usually extends over 30 degrees of latitude. This made it necessary to separate the maps into three groups to obtain the best results. One group consisted of maps with Lows centered in the area from latitude 45° N. to 30° N. and from longitude 150° W. to 130° W. For these Lows the pressures at the points 50° N., 125° W. and 40° N., 135° W. measured the gradient offshore and to a large extent measured the intensity of the trough. These two variables were used as coordinates in plotting figure 11. On this graph a line was drawn, above which most of the cases were "no-rain". However, a search for two additional variables was required to further stratify the cases below the line. The pressure difference between 40° N., 130° W. and 40° N., 160° W. usually covered the breadth of the trough and it showed some relationship to rain. Another variable which was more significant than many others tried was the pressure gradient north to south across the western part of the Plateau (pressure difference between 50° N., 115° W. and 35° N., 115° W.). The results of using these variables as coordinates in plotting the cases below the curve (fig. 11) are shown in figure 12. In

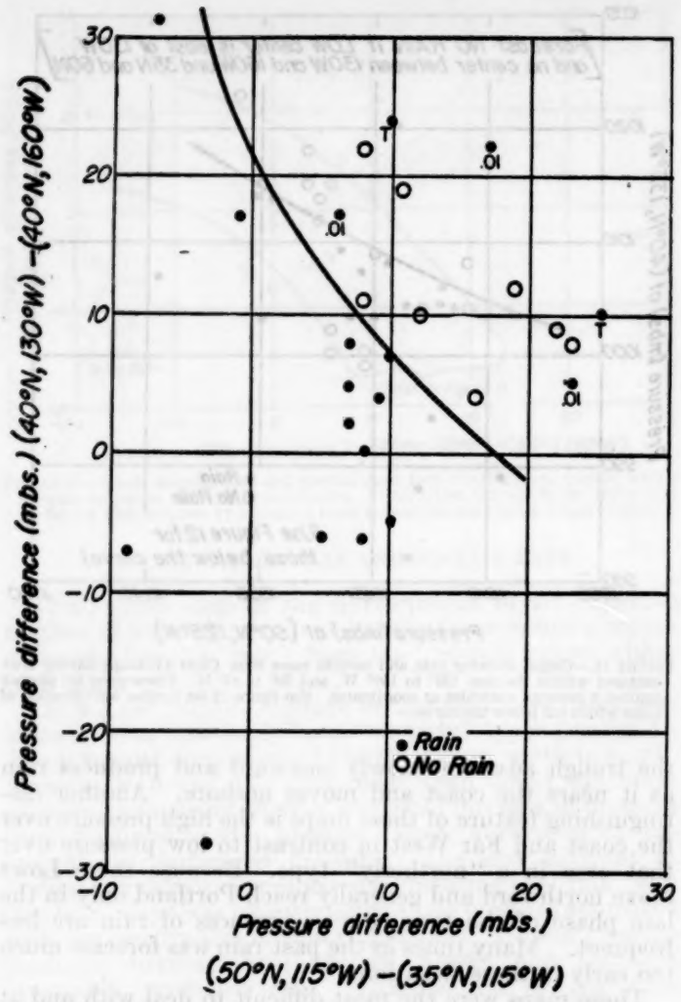

FIGURE 12.—Graph for use with cases which fall below the curve in figure 11. These cases are here replotted against 2 secondary variables as coordinates.

figure 12, the five misses on the "no-rain" side of the curve are not too discouraging since each map produced only a trace, or .01 inch, of rain.

The second group of maps were those with Lows between 45° N. and 60° N. and those with Lows at any latitude west of longitude 150° W. On the east side of the low pressure trough which is common to a southerly type, the isobars lie roughly along the meridians. The pressure difference between Portland and the point 60° N., 140° W. was found to give a satisfactory indication of the strength of the southerly flow along the coast and was chosen as the first variable for plotting figure 13 for this group of maps. When the pressure decreases at a faster rate at 60° N., 140° W. than it does at Portland, the southerly flow becomes stronger and the tendency for Lows to follow a northward course and pass inland north of Portland increases.

The absolute pressure at the point 50° N., 135° W. was selected as the other variable for plotting figure 13. This variable gives some measure of the intensity of the trough and its location or movement. When the trough nears the point the rain area usually extends over Portland within 48 hours. Low pressure at the point indicates

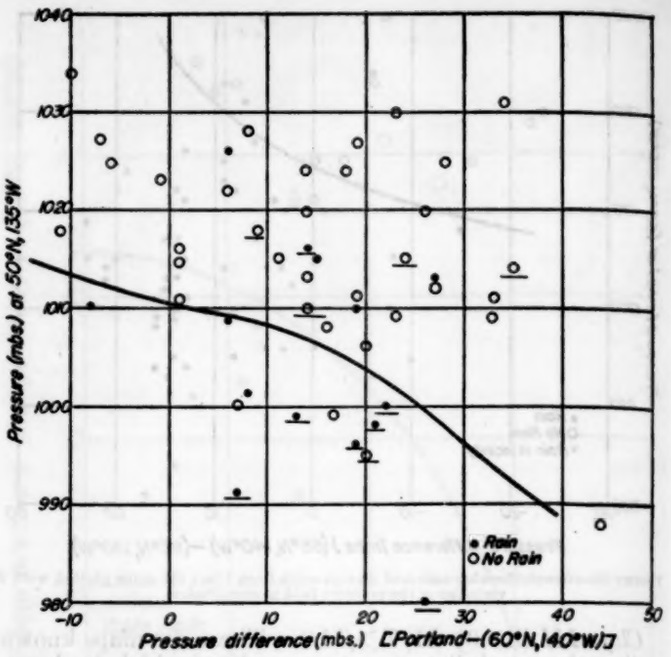

FIGURE 13.—Graph showing rain and no-rain cases from Class IV maps having a low center between 45° and 60° N. or at any latitude west of 150° W. These cases are plotted against variables of the pressure field as coordinates. Cases having lows between the coast and 150° W. and north of 45° N. are underlined.

that the trough (or Low) is approaching the coast, whereas high pressure indicates that the high pressure system, which is found over the west coast in a southerly type, still dominates the coastal weather.

It will be seen from figure 13 that on southerly maps with Lows west of 150° W. the stratification of "rain" and "no-rain" cases was not entirely satisfactory. This suggests that in any revision of this method, these maps may have to be treated separately as it may be that the original points chosen for typing maps will require revision whenever there is a negative meridional circulation.

Frequently there were Class IV maps with Lows in both areas upon which the above two groupings depend. Each such case was treated individually according to procedures for both groups. In tests it was found advisable to forecast rain if the objective forecast of either group indicated rain.

The final group of southerly maps were those with a low center east of 130° W. and no center from 130° W. to 160° W. and from 35° N. to 60° N. Lows centered east of 130° W. were moving onshore and none in the sample produced rain. Thus, for this group of Class IV maps the objective method always calls for a forecast of "no-rain."

Class V (0>M>Z).—Maps in this class may be similar to figure 7 except that usually only the southernmost Low is present and the two large Highs meet north of this low pressure center. There were only 6 maps of this class in the total of 297 maps of the original sample and only 3 in the 121 maps on which tests were made. Because the cases in the sample were too few to permit obtaining significant results, no forecasting technique was developed. Therefore, it is merely noted in passing that there were 2 "rain" days and 4 "no-rain" days in the original sample and 3 "rain" days and no "no-rain" days in the test sample.

VERIFICATION

ORIGINAL CASES

Verification of forecasts made by the objective method for classes I, II, III, and IV of the original cases used in developing the system is given in table 1.

TABLE 1.—*Verification of forecasts for original cases.*

CLASS I

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	19	0	19	Percent correct=97
No rain	1	8	9	Skill score [1]=.92
Total	20	8	28	

CLASS II

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	96	0	96	Percent correct=91
No rain	10	0	10	Skill score=.77
Total	106	0	106	

CLASS III

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	52	3	55	Percent correct=91
No rain	3	12	15	Skill score=.81
Total	55	15	70	

CLASS IV

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	22	11	33	Percent correct=84
No rain	3	51	54	Skill score=.70
Total	25	62	87	

CLASSES I, II, III AND IV.

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	189	14	203	Percent correct=89
No rain	17	71	88	Skill score=.77
Total	206	85	291	

[1] The skill score, S_s, in this study is defined by

$$S_s=\frac{C-E_c}{T-E_c}$$

where C=number of correct forecasts,
E_c=number of forecasts expected to be correct due to chance, and
T=total number of forecasts.

It has a value of unity when all forecasts are correct, and zero when the number of correct forecasts is equal to the number expected to be corrected due to chance. In this study, the number of forecasts expected to be correct by chance is defined as the number expected correct from an equal number of random forecasts of rain days and no-rain days, with the proportion of rain days to no-rain days in accordance with climatological averages for the forecast period. Hence, the number of forecasts expected to be correct on this basis may be determined by

$$E_c=R\times f_r+N(1-f_r),$$

where R=observed number of rain days,
N=observed number of no-rain days, and
f_r=relative frequency of occurrence of rain days during the period covered by forecasts, determined from climatological data (Ex: If during January and February, 59 days, it rains on the average 37 days, f_r would be 37/59).

INDEPENDENT CASES

To subject this system of forecasting to a test in cases independent of those used in the investigation, the months of January and February 1937, and December 1930, and 1933, were selected. A preconception was that the weather regime at Portland in December is normally about the same as in January and February. These four months were chosen arbitrarily although the total days with rain was 27 percent above the average as shown in the following table. In December 1933 rain fell on every day. On the other hand December 1930 had the normal number of rainy days but the total precipitation for the month was abnormally low. The skill score over the Climatological forecasts and the percentage of hits were just a little higher in the two Decembers than in the January and February test months. Other tests made from day to day during the winter 1947–1948 gave results comparable to those of the test months.

A break-down of the maps in the four test months was as follows:

Class	Number of maps	Rain days	No-rain days
I	27	18	9
II	33	28	5
III	41	32	9
IV	17	12	5
V	3	3	0
Total	121	93	28

Verification of forecasts made from these independent data for December 1930 and 1931, and January and February 1937 gave the results indicated in table 2.

TABLE 2.—*Verification of forecasts for independent cases*

CLASS I

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	16	0	18	Percent correct=85
No rain	4	5	9	Skill score=.69
Total	22	5	27	

CLASS II

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	28	0	28	Percent correct=85
No rain	5	0	5	Skill score=.64
Total	33	0	33	

CLASS III

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	28	4	32	Percent correct=83
No rain	3	6	9	Skill score=.61
Total	31	10	41	

CLASS IV

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	9	3	12	Percent correct=82
No rain	0	5	5	Skill score=.62
Total	9	8	17	

CLASSES I, II, III, AND IV

OBSERVED	FORECAST: Rain	FORECAST: No rain	Total	
Rain	83	7	90	Percent correct=84
No rain	12	16	28	Skill score=.63
Total	95	23	118	

CONCLUSIONS

1. The method of forecasting described here is highly objective. It can reduce differences of opinion as to map types and reduce the number of differing forecasts. However, it should be used as an aid to rather than as a substitute for the usual forecasting precepts. Study of additional maps is necessary in order to either confirm the results in this paper or to develop more efficient parameters.

2. Although data are based on 1300 GMT maps experience has shown that satisfactory results can be obtained with maps for other times of the day.

3. In this method of determining map types by mathematical relationships between circulation indices, successive 6-hourly maps may fluctuate between two or even three types when one or both indices are small. The movement of a Low or a small High across one of the key coordinates will cause a fall and rise of several millibars within the course of a day. This results in a slight change in one of the indices, but often the change is sufficient to shift the maps from one type to another when maps are only six hours apart. In such cases it is advisable to assume the original type unless there is evidence that the change in type is permanent.

4. From forecasts made by this method from successive 6-hourly maps the time of beginning and ending of rain often can be anticipated within a few hours. This manner of timing can be useful when the location or speed of fronts cannot be determined, and useful also during periods of shower activity.

5. Whenever the objective forecast is strongly opposed to the forecast obtained in the usual manner it is advisable for the forecaster to examine the maps more carefully and review his reasoning. In day-to-day tests four instances of this kind are recalled. A reevaluation of the data on the maps revealed evidence of phenomena which would cause rain, and the original analyses were revised. Reports were scarce and the little data had to be weighed carefully, nevertheless these phenomena were borne out by subsequent charts.

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ADDITIONAL TESTS OF COUNTS' OBJECTIVE METHOD OF FORECASTING WINTER RAIN FOR PORTLAND, OREGON

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The Weather Bureau District Forecast Staff at Seattle, Washington, made practical use of Counts' objective method of forecasting precipitation for the second day in advance at Portland, Oregon, during the winter season of 1948–49. In the application of the method, the Seattle Staff rigidly followed the rules set forth by Counts, except that the forecast period was considered to be 24–48 hours after map time instead of 20–44 hours used by Counts; for the purpose of this test no attempt was made to improve the forecasting results by following suggestions contained in his article. A record of the M and Z values for the 0030 GMT and 1230 GMT maps was kept during the months of November, December, January, February and March. Each case was immediately classified and the forecast obtained from the scatter diagrams was recorded and also used by the staff forecaster as an aid in making the official forecast.

There were 302 maps used in the test and they were segregated as follows:

Class	Number of maps	Rain days	No-rain days
I	26	18	8
II	133	113	20
III	72	48	24
IV	61	27	34
V	10	2	8
Total	302	208	94

The ratio of "rain" days to "no-rain" days is very nearly the same as found in Counts' original investigation of 297 cases. The greater number of Class II cases and fewer Class IV cases in the present test compared to the original study is very noticeable.

VERIFICATION RESULTS FOR WINTER 1948–49

Verification of the objective forecasts for Portland for the 302 cases is given in Table 1:

TABLE 1.—*Verification of objective forecasts for Portland, winter 1948–49*

		FORECAST: Rain	FORECAST: No rain	FORECAST: Total	
CLASS I	Rain	15	3	18	
OBSERVED	No rain	3	5	8	Percent correct=77
	Total	18	8	26	Skill score=.50
CLASS II	Rain	113	0	113	
OBSERVED	No rain	20	0	20	Percent correct=85
	Total	133	0	133	Skill score=.66
CLASS III	Rain	40	8	48	
OBSERVED	No rain	8	16	24	Percent correct=78
	Total	48	24	72	Skill score=.53
CLASS IV	Rain	15	12	27	
OBSERVED	No rain	1	33	34	Percent correct=79
	Total	16	45	61	Skill score=.58
CLASS V[1]	Rain	0	2	2	
OBSERVED	No rain	0	8	8	Percent correct=80
	Total	0	10	10	Skill score=.67
ALL CLASSES	Rain	183	25	208	
OBSERVED	No rain	32	62	94	Percent correct=81
	Total	215	87	302	Skill score=.60

[1] Editor's note—Counts' data for Class V were too few to permit obtaining significant results and developing an objective procedure. Thus, this part of table 1 is not a verification of forecasts by Counts' method, but is a verification of forecasts made on the assumption that all class V cases give "no-rain."

Before commenting on the results of the 1948–49 test, it might be well to point out three factors which undoubtedly contributed to scores lower than those in Counts' paper. First, as already mentioned, this test verified forecasts 24–48 hours after map time, while Counts used the period 20–44 hours after map time. In other words, the method was tested for a forecast period four hours farther into the future than the period for which it was developed. Next, the winter season was extreme with respect to precipitation and temperature over the Pacific Northwest.[2] The weather of the test months may be described briefly as follows: November, moderately wet and cold; December, precipitation moderately above normal and exceptionally cold; January, extremely cold and extremely dry; February, very cold and wet; March, rather cool with less than normal precipitation. Finally, bias introduced by testing with extreme data was approximately doubled by verifying forecasts made on two maps daily instead of one as in the original paper. While Counts concluded that the objective method could be used with maps for times other than 1300 GMT, it was found in this study that the percentage of correct forecasts on 1230 GMT data was 82 and on 0030 GMT data was 80. Possibly this variation is not great enough to be significant, but had the 0030 GMT data been discarded for the past season it would have given a higher percentage of verification to the scheme.

DISCUSSION OF VERIFICATION RESULTS

CLASS I

Table 1 shows that the percentage of correct forecasts for Class I during the 1948–49 season was 77, a value 20 percent below that for Counts' original data and 8 percent below that in Counts' test for independent cases. The increase in errors was mostly in the "no-rain" forecasts—rain occurring when none was forecast. Figure 9 of Counts' article shows a curve clearly separating "rain" cases from "no-rain" cases. A similar scatter diagram prepared for the 1948–49 data did not disclose any grouping which would permit easy separation of cases. Counts states that his diagrams were prepared on relatively few cases and that the results should be used with caution. The test by the Seattle Staff suggests that additional study is necessary to select better parameters for stratifying the Class I cases which were plotted on Figure 9.

CLASS II

Class II cases produced the highest percentage of correct forecasts of all classes in the 1948–49 test. The percentage, 85, was slightly lower than the 91 percent for Counts' original data but was the same as for Counts' test data.

Noting that Counts' method calls for a forecast of "rain" for all Class II cases, the Seattle Staff found two factors which, if taken into account, might increase the accuracy of forecasts for this class by providing for a forecast of "no-rain" in certain situations. First, when the western half of the North American Continent is covered by cold air there is a tendency for Lows of the northwesterly type to move southeastward off the west coast of the United States far enough out to sea that the precipitation area of the storm does not extend to Portland. Second, for cases which result in "no-rain" and which have a large Z value, the error of the "rain" forecast is often an error in timing—the rain usually occurs prior to the verification period.

[2] See Klein, William H., "The Unusual Weather and Circulation of the 1948–1949 Winter," *Monthly Weather Review*, vol. 77, No. 4, April 1949, pp. 99–113.

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CLASS III

The percentage of correct forecasts for Class III cases was only 78 as compared with 91 percent for Counts' original data and 83 percent for Counts' test data.

Improvement in forecasting for this Class by favoring rain forecasts for large values of Z is suggested by the important role played by the westerlies and southwesterlies in producing rain over the Pacific Northwest. If a line having the equation $10Z+7.5M-75=0$ is drawn on Count's figure 2 it will be noted that there are fewer "no-rain" cases on the side having the greater Z values. Had the Class III cases for which the objective method forecast no rain at Portland and which fell to the right of the line been changed to call for rain, the verification of this Class in the test by the Seattle Staff would have been increased to 85 percent and the skill over Climatological forecast raised to .68.

CLASS IV

Seventy-nine percent of the objective forecasts for Class IV cases were correct during the 1948–49 season. The exceptions are baffling. A few days of rain when none was forecast could be attributed to precipitation occurring with wave development on the cold front of outbreaks of Polar Air west of the Continental Divide. Seven of the misses occurred in January, 2 in February and 3 in March. The fact that January was extremely cold over the Pacific Northwest undoubtedly lessens the value of data for this month as test data.

CLASS V

There were too few cases of this class in the original work and tests for Counts to draw conclusions. Data gathered during the past season indicate that Class V cases will verify high on "no-rain" forecasts (table 1).

APPLICATION OF METHOD TO OTHER STATIONS

In using the objective technique, the Seattle forecasters appreciated the simple set of coordinates which Counts selected and also the fact that the same set is used for all classes. Obviously, a method such as Counts' will work best for locations where precipitation is closely related to the flow pattern of the lower part of the atmosphere as reflected by surface isobars. Even though mountain barriers influence precipitation over all of the Seattle Forecast District and the circulation of the atmosphere at higher levels becomes more important than the surface flow in the production of precipitation, it was decided to apply the forecasts for Portland obtained by Counts' technique to the stations at Seattle, Medford, Spokane, and Boise. The results of the verification by months are tabulated in Table 2:

TABLE 2.—*Percentage of correct forecasts by Months and Seasons and Skill over Climatological Forecast for Season*

Station	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Season*	*Skill Score*
Portland	92	77	68	88	77	81	0.60
Seattle	90	76	65	80	69	77	.53
Medford	77	68	79	80	76	75	.52
Spokane	75	74	66	70	64	70	.41
Boise	73	68	79	68	61	70	.43

The final results are much as expected and indicate that the objective forecasts for Portland might be applied with some reservations to Seattle and Medford and produce creditable results. For instance, it was noted that Class II frequently failed to give rain at Seattle because the city lies in the lee of the Olympic Mountains when the flow is from the northwest.

November and February proved to be the best verification months for all stations except Boise which had a high verification for January, and Medford with highs in January and February. In January there were a large number of "hits" credited for "no-rain" forecasts at Boise when a trace of rain occurred and also credited for "rain" forecasts when a trace of rain fell on the day before or following a day having a measurable amount, in accordance with verification procedure used by Counts. The fact that Medford verified so high in January may be attributed to the reason mentioned earlier that Class II was affected by the cold air over the continent: the storms forced south of Portland frequently gave rain to Medford.

Since the method did not give good results for Spokane and Boise, much time was spent trying to find coordinates and parameters which would work equally well for Boise as for Portland. Results were negative and it will probably be necessary to correlate upper air data in order to obtain satisfactory results.

CONCLUSIONS

This investigation revealed that the splendid and successful results obtained by Counts stemmed from long hours of research and a thorough knowledge of forecasting for the Pacific Northwest. It was found that his method does what he claims and is best considered as an aid to the forecaster and not a tool which will supplant reasoning in forecasting. The method does, however, suggest techniques for the use of high speed electronic computers which would be able to handle many more variables simultaneously.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR MAY 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during May 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,005.5 mb.)				Albuquerque, N. Mex. (835.0 mb.)				Atlanta, Ga. (982.6 mb.)				Big Spring, Tex. (924.3 mb.)				Bismarck, N. Dak. (952.8 mb.)				Boise, Idaho (911.7 mb.)				Brownsville, Tex. (1,011.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	86	13.5	75	31	1,620	19.3	31	31	300	20.3	71	31	774	20.6	63	31	505	148	61	31	868	18.7	45	31	6	25.7	85
1,000	31	132	(*)	----	31	34	(*)	----	31	147	(*)	----	31	80	(*)	----	31	90	(*)	----	31	64	(*)	----	31	108	25.0	84
950	31	569	13.3	57	31	494	(*)	----	31	595	21.1	58	31	535	(*)	----	31	531	(*)	----	31	517	(*)	----	31	559	22.0	81
900	31	1,020	10.8	60	31	973	(*)	----	31	1,058	18.2	59	31	1,006	22.6	58	31	986	13.4	52	31	979	18.7	41	31	1,028	20.9	65
850	31	1,494	7.5	63	31	1,467	(*)	----	31	1,545	14.4	63	31	1,502	20.0	54	31	1,465	10.1	56	31	1,466	15.3	40	31	1,521	18.6	58
800	31	1,990	4.1	64	31	1,987	17.7	28	31	2,054	10.6	65	31	2,022	16.6	49	31	1,967	7.2	60	31	1,976	11.2	44	31	2,040	16.5	45
750	31	2,516	1.4	54	31	2,537	13.4	30	31	2,594	7.1	58	30	2,573	12.6	50	31	2,502	4.3	59	31	2,514	6.7	48	31	2,592	14.0	35
700	31	3,065	−1.3	50	31	3,109	8.3	35	31	3,153	3.7	54	30	3,143	8.6	43	31	3,054	1.0	57	31	3,072	2.3	52	31	3,165	10.4	34
650	31	3,656	−4.6	47	31	3,717	3.0	41	31	3,754	.4	45	30	3,756	4.1	43	31	3,651	−2.7	53	31	3,669	2.3	53	30	3,779	5.9	38
600	31	4,278	−8.1	44	31	4,357	−2.6	48	31	4,389	−3.2	38	30	4,398	−.7	43	31	4,276	−6.6	48	31	4,296	−7.0	53	30	4,427	−1.2	42
550	30	4,954	−12.3	38	31	5,041	−8.3	52	29	5,069	−7.4	35	30	5,084	−5.9	40	31	4,955	−11.4	49	31	4,971	−11.6	52	30	5,118	−3.7	38
500	29	5,673	−17.0	38	31	5,772	−13.9	51	28	5,805	−12.2	----	30	5,826	−11.1	34	31	5,674	−16.4	47	31	5,693	−16.8	49	30	5,866	−9.0	38
450	28	6,459	−22.6	----	31	6,569	−19.5	42	28	6,608	−17.8	----	30	6,633	−16.8	----	31	6,464	−22.0	----	31	6,481	−22.4	----	30	6,681	−14.7	38
400	28	7,306	−28.6	----	31	7,429	−25.7	----	28	7,473	−24.2	----	30	7,503	−23.1	----	31	7,313	−28.5	----	31	7,329	−28.8	----	30	7,556	−21.0	----
350	28	8,247	−36.0	----	31	8,382	−33.2	----	28	8,432	−31.7	----	30	8,467	−30.3	----	31	8,255	−36.0	----	31	8,270	−36.2	----	30	8,529	−28.1	----
300	28	9,299	−44.2	----	31	9,447	−41.0	----	28	9,502	−40.2	----	30	9,544	−38.6	----	30	9,305	−44.4	----	31	9,320	−44.7	----	30	9,617	−36.0	----
250	26	10,499	−51.6	----	30	10,665	−49.4	----	27	10,725	−49.7	----	29	10,768	−47.8	----	29	10,500	−53.0	----	30	10,515	−54.1	----	29	10,861	−44.8	----
200	23	11,940	−57.7	----	30	12,099	−57.2	----	27	12,151	−59.5	----	29	12,210	−57.0	----	23	11,914	−59.3	----	28	11,921	−59.3	----	27	12,320	−55.2	----
175	20	12,757	−58.8	----	26	12,938	−58.5	----	26	12,982	−62.8	----	28	13,050	−60.2	----	17	12,759	−56.9	----	26	12,752	−57.6	----	27	13,162	−60.4	----
150	18	13,726	−58.8	----	18	13,906	−58.2	----	22	13,938	−62.7	----	27	14,009	−61.7	----	16	13,736	−55.6	----	22	13,734	−55.9	----	25	14,112	−64.4	----
125	14	14,860	−57.0	----	16	15,055	−60.5	----	15	15,051	−63.4	----	21	15,142	−63.3	----	12	14,890	−55.9	----	17	14,877	−56.2	----	19	15,237	−67.3	----
100	8	16,294	−60.0	----	6	16,439	−63.5	----	10	16,414	−65.7	----	10	16,490	−65.7	----	8	16,272	−55.7	----	9	16,271	−58.5	----	13	16,575	−72.1	----
80	----	----	----	----	----	----	----	----	5	17,751	−66.9	----	6	17,829	−66.4	----	----	----	----	----	----	----	----	----	8	17,874	−72.7	----

	Buffalo, N. Y. (989.9 mb.)				Camaguey, Cuba [1] (---- mb.)				Caribou, Maine (991.7 mb.)				Charleston, S. C. (1,015.3 mb.)				Ciudad Victoria, Mex. (971.3 mb.)				Columbia, Mo. (986.1 mb.)				Dodge City, Kans. (922.4 mb.)			
Surface	31	221	12.8	67	----	----	----	----	31	191	8.3	73	31	13	18.9	90	29	335	29.1	60	31	239	18.7	73	31	792	16.6	80
1,000	31	134	(*)	----	----	----	----	----	31	122	(*)	----	31	144	20.5	84	29	75	(*)	----	31	118	(*)	----	31	94	(*)	----
950	31	572	13.9	55	----	----	----	----	31	553	9.0	60	31	580	19.6	68	29	533	27.2	60	31	566	19.1	63	31	541	(*)	----
900	31	1,021	11.2	56	----	----	----	----	31	993	6.0	62	31	1,052	16.5	67	29	1,008	23.2	64	31	1,023	16.1	64	31	1,002	17.7	69
850	31	1,496	7.8	58	----	----	----	----	31	1,459	3.2	63	31	1,537	13.4	64	29	1,505	19.4	71	31	1,507	13.2	65	31	1,490	15.5	61
800	31	1,993	4.3	62	----	----	----	----	31	1,948	−.1	62	31	2,044	10.3	58	29	2,025	15.9	73	31	2,015	10.1	60	31	2,002	13.1	54
750	31	2,519	1.2	59	----	----	----	----	31	2,470	−2.5	61	31	2,582	7.2	53	29	2,575	13.3	58	31	2,557	6.8	56	31	2,544	9.5	52
700	31	3,068	−1.7	54	----	----	----	----	31	3,008	−5.0	59	31	3,144	3.9	50	29	3,150	10.2	46	31	3,112	3.3	53	31	3,111	5.7	50
650	31	3,660	−4.7	47	----	----	----	----	31	3,593	−7.9	54	30	3,744	.2	50	29	3,764	6.2	45	31	3,712	−.3	49	31	3,714	1.4	47
600	31	4,281	−8.1	43	----	----	----	----	31	4,206	−11.1	49	30	4,380	−3.7	46	29	4,413	1.8	46	31	4,346	−4.3	44	31	4,352	−3.0	46
550	30	4,955	−12.3	38	----	----	----	----	31	4,873	−15.2	46	29	5,067	−7.7	43	28	5,110	−3.4	48	31	5,026	−8.8	42	30	5,032	−7.9	41
500	30	5,675	−17.0	35	----	----	----	----	31	5,583	−19.8	44	29	5,802	−12.4	40	27	5,856	−8.6	48	31	5,757	−13.8	40	30	5,767	−13.2	36
450	30	6,462	−22.6	----	----	----	----	----	31	6,363	−25.0	----	29	6,603	−18.0	39	27	6,679	−13.4	39	31	6,555	−19.4	37	30	6,565	−18.7	33
400	27	7,307	−28.8	----	----	----	----	----	31	7,203	−31.1	----	29	7,469	−24.3	40	27	7,554	−19.6	38	30	7,411	−25.8	----	30	7,429	−25.2	----
350	26	8,247	−36.0	----	----	----	----	----	31	8,136	−38.1	----	29	8,428	−31.7	39	27	8,531	−26.6	----	30	8,363	−33.2	----	30	8,383	−32.6	----
300	24	9,312	−43.9	----	----	----	----	----	31	9,181	−45.3	----	28	9,499	−39.9	----	27	9,626	−34.9	----	30	9,427	−41.6	----	30	9,452	−40.5	----
250	23	10,520	−52.1	----	----	----	----	----	29	10,388	−52.2	----	28	10,719	−49.2	----	26	10,875	−44.8	----	30	10,639	−50.6	----	30	10,668	−50.0	----
200	15	11,970	−59.0	----	----	----	----	----	17	11,798	−55.1	----	25	12,159	−59.0	----	25	12,333	−56.5	----	26	12,060	−59.0	----	29	12,101	−58.9	----
175	11	12,848	−62.2	----	----	----	----	----	16	12,651	−54.8	----	22	12,990	−62.0	----	23	13,169	−62.0	----	23	12,902	−61.2	----	28	12,927	−60.5	----
150	7	13,817	−63.7	----	----	----	----	----	11	13,620	−52.8	----	15	13,937	−61.5	----	18	14,124	−67.2	----	13	13,877	−61.2	----	27	13,891	−59.4	----
125	----	----	----	----	----	----	----	----	----	----	----	----	10	15,068	−62.2	----	12	15,215	−70.9	----	9	15,018	−61.7	----	23	15,028	−60.2	----
100	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	16,508	−74.8	----	7	16,391	−63.9	----	20	16,413	−62.4	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	14	17,793	−64.0	----

Standard pressure surface (mb.)	El Paso, Tex. (878.1 mb.)				Ely, Nev. (806.6 mb.)				Glasgow, Mont. (936.2 mb.)				Grand Junction, Colo. (850.0 mb.)				Great Falls, Mont. (885.0 mb.)				Greensboro, N. C. (985.8 mb.)				Hatteras, N. C. (1,017.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	1,195	24.5	23	31	1,908	11.5	59	31	648	16.7	42	31	1,474	16.3	43	31	1,128	14.8	46	31	273	16.9	86	31	3	18.9	85
1,000	31	37	(*)	----	31	69	(*)	----	31	78	(*)	----	31	62	(*)	----	31	77	(*)	----	31	149	(*)	----	31	151	18.9	85
950	31	506	(*)	----	31	518	(*)	----	31	525	(*)	----	31	516	(*)	----	31	526	(*)	----	31	591	18.5	63	31	595	17.0	69
900	31	988	(*)	----	31	983	(*)	----	31	983	16.1	39	31	985	(*)	----	31	993	(*)	----	31	1,053	15.9	64	31	1,051	14.8	65
850	31	1,479	23.6	24	31	1,465	(*)	----	31	1,465	12.1	43	31	1,473	(*)	----	31	1,468	13.2	43	31	1,536	12.7	66	31	1,532	12.0	63
800	31	2,004	19.3	26	31	1,977	12.2	51	31	1,969	8.2	48	31	1,989	14.6	40	31	1,974	9.2	47	31	2,043	9.1	68	31	2,038	9.1	60
750	31	2,557	14.5	28	31	2,517	8.5	47	31	2,498	4.3	53	31	2,531	10.1	45	31	2,510	4.9	53	31	2,579	5.5	66	31	2,575	6.1	53
700	31	3,130	9.4	31	31	3,081	4.1	50	31	3,056	.6	55	31	3,099	5.4	51	31	3,064	.7	57	31	3,136	2.1	59	31	3,132	2.9	45
650	31	3,741	4.3	34	31	3,680	−.9	54	31	3,648	−3.6	54	31	3,702	.4	58	30	3,658	−3.7	59	30	3,734	−1.1	50	31	3,727	−.8	41
600	31	4,384	−.8	36	31	4,312	−5.9	59	31	4,274	−7.8	52	31	4,336	−4.7	62	30	4,284	−7.9	56	29	4,365	−4.6	42	31	4,362	−4.7	38
550	31	5,073	−6.0	35	31	4,986	−11.1	60	31	4,947	−12.4	51	31	5,016	−9.8	62	30	4,958	−12.2	51	29	5,043	−8.7	38	29	5,044	−8.8	33
500	31	5,811	−11.6	31	31	5,712	−16.3	52	31	5,667	−17.3	44	31	5,744	−14.8	52	30	5,677	−17.3	45	29	5,777	−13.2	35	29	5,777	−13.7	32
450	31	6,618	−17.0	----	31	6,503	−22.1	----	31	6,452	−23.0	----	30	6,539	−20.5	----	30	6,463	−23.2	----	29	6,576	−18.7	31	28	6,571	−19.3	----
400	31	7,484	−23.7	----	31	7,351	−28.5	----	31	7,300	−29.4	----	30	7,395	−27.0	----	30	7,308	−29.9	----	29	7,439	−25.3	----	28	7,435	−25.8	----
350	31	8,444	−31.5	----	30	8,288	−36.3	----	31	8,238	−36.9	----	30	8,342	−34.5	----	30	8,244	−37.3	----	28	8,390	−32.6	----	28	8,387	−33.0	----
300	30	9,517	−39.8	----	30	9,338	−44.7	----	31	9,285	−45.4	----	29	9,395	−43.1	----	29	9,292	−45.6	----	28	9,457	−40.7	----	27	9,451	−40.9	----
250	28	10,745	−49.0	----	30	10,535	−52.7	----	29	10,477	−54.7	----	25	10,617	−51.3	----	26	10,481	−54.7	----	26	10,662	−50.0	----	27	10,665	−50.1	----
200	24	12,191	−57.2	----	25	11,950	−55.9	----	29	11,882	−60.3	----	23	12,048	−57.8	----	26	11,883	−59.7	----	20	12,124	−59.1	----	26	12,088	−58.3	----
175	24	13,028	−60.2	----	23	12,802	−56.8	----	26	12,711	−58.0	----	17	12,901	−59.0	----	24	12,709	−57.9	----	18	12,963	−61.2	----	26	12,923	−60.3	----
150	21	13,989	−61.2	----	23	13,777	−56.8	----	23	13,676	−56.1	----	10	13,867	−57.6	----	19	13,690	−55.9	----	11	13,920	−60.2	----	26	13,884	−59.8	----
125	16	15,115	−63.3	----	17	14,925	−57.9	----	15	14,842	−56.1	----	5	15,015	−57.6	----	19	14,847	−56.8	----	----	----	----	----	23	15,017	−60.9	----
100	13	16,471	−67.2	----	15	16,327	−60.4	----	7	16,256	−57.8	----	----	----	----	----	15	16,263	−57.3	----	----	----	----	----	16	16,397	−63.0	----
80	7	17,802	−67.6	----	9	17,713	−61.2	----	----	----	----	----	----	----	----	----	14	17,674	−58.4	----	----	----	----	----	9	17,772	−63.1	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10	19,485	−58.1	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	5	20,626	−57.5	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during May 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba [1] (---- mb.)				Honolulu, T. H. (1,016.0 mb.)				International Falls, Minn. (971.0 mb.)				Joliet, Ill. (994.5 mb.)				Lake Charles, La. (1,014.3 mb.)				Lander, Wyo. (827.5 mb.)				Las Vegas, Nev. (932.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	----	----	----	----	31	3	25.8	61	31	360	10.3	68	31	178	14.1	70	31	5	23.1	84	31	1,666	12.0	59	31	660	23.3	26
1,000	----	----	----	----	31	142	23.5	63	31	111	(*)	----	31	130	(*)	----	31	129	23.6	78	31	72	(*)	----	31	45	(*)	----
950	----	----	----	----	31	592	19.7	71	31	545	11.9	59	31	571	16.0	55	31	578	21.0	75	31	522	(*)	----	31	501	(*)	----
900	----	----	----	----	31	1,052	16.4	77	31	993	9.2	59	31	1,023	13.3	58	31	1,044	18.4	67	31	985	(*)	----	31	972	22.6	28
850	----	----	----	----	31	1,537	13.6	75	31	1,464	6.2	63	31	1,502	10.1	60	31	1,532	15.9	53	31	1,468	(*)	----	31	1,465	18.3	28
800	----	----	----	----	31	2,047	12.9	50	31	1,959	3.8	59	31	2,004	7.3	57	31	2,045	13.6	42	31	1,979	11.9	52	31	1,979	13.7	32
750	----	----	----	----	31	2,591	10.7	36	31	2,485	1.3	56	31	2,540	4.7	50	31	2,593	11.0	34	31	2,518	8.0	52	31	2,520	8.8	37
700	----	----	----	----	31	3,161	8.3	29	31	3,033	−1.8	51	31	3,092	1.5	45	31	3,159	7.6	30	31	3,081	3.8	54	31	3,083	3.8	42
650	----	----	----	----	31	3,768	4.9	30	31	3,626	−5.3	53	31	3,690	−2.2	43	31	3,767	3.4	33	31	3,679	−1.0	59	31	3,679	−1.2	42
600	----	----	----	----	31	4,417	.7	33	31	4,243	−8.8	50	31	4,317	−6.2	42	31	4,408	−1.3	32	31	4,312	−5.8	60	31	4,313	−5.9	37
550	----	----	----	----	31	5,108	−3.6	34	30	4,919	−13.0	46	31	4,995	−10.6	39	31	5,096	−5.9	30	31	4,989	−10.7	59	31	4,989	−10.4	34
500	----	----	----	----	31	5,856	−8.6	29	30	5,635	−17.7	43	31	5,719	−15.2	39	29	5,837	−11.1	----	31	5,713	−15.8	53	31	5,715	−15.8	33
450	----	----	----	----	31	6,672	−14.0	30	30	6,420	−23.4	----	31	6,512	−20.9	----	29	6,646	−16.6	----	31	6,506	−21.5	----	31	6,504	−21.8	----
400	----	----	----	----	31	7,550	−20.1	----	30	7,266	−29.7	----	31	7,366	−27.3	----	28	7,517	−23.1	----	31	7,355	−28.1	----	31	7,356	−28.5	----
350	----	----	----	----	31	8,525	−27.7	----	29	8,202	−37.1	----	29	8,313	−34.8	----	28	8,475	−30.9	----	31	8,297	−36.0	----	31	8,299	−35.6	----
300	----	----	----	----	31	9,614	−36.1	----	26	9,243	−45.4	----	29	9,370	−43.2	----	28	9,549	−39.4	----	31	9,348	−44.9	----	31	9,355	−42.8	----
250	----	----	----	----	31	10,854	−45.8	----	24	10,434	−53.6	----	29	10,573	−52.0	----	28	10,770	−49.3	----	30	10,544	−54.2	----	31	10,562	−50.5	----
200	----	----	----	----	30	12,307	−56.7	----	21	11,850	−57.7	----	27	12,000	−58.6	----	28	12,198	−59.0	----	26	11,954	−59.7	----	30	11,992	−56.5	----
175	----	----	----	----	30	13,143	−62.0	----	18	12,681	−58.2	----	22	12,863	−60.7	----	28	13,028	−62.6	----	22	12,796	−58.6	----	30	12,835	−57.9	----
150	----	----	----	----	30	14,085	−66.0	----	11	13,638	−54.7	----	20	13,825	−60.3	----	27	13,970	−64.1	----	16	13,772	−57.2	----	27	13,808	−57.5	----
125	----	----	----	----	30	15,184	−68.4	----	5	14,797	−54.5	----	17	14,958	−60.0	----	24	15,082	−66.8	----	10	14,932	−57.8	----	25	14,955	−60.1	----
100	----	----	----	----	27	16,513	−69.6	----	----	----	----	----	14	16,354	−61.3	----	22	16,416	−69.7	----	7	16,338	−58.1	----	22	16,344	−61.5	----
80	----	----	----	----	24	17,850	−67.7	----	----	----	----	----	11	17,720	−61.3	----	18	17,745	−69.6	----	----	----	----	----	16	17,726	−62.5	----
60	----	----	----	----	17	19,595	−63.9	----	----	----	----	----	6	19,514	−60.2	----	9	19,462	−64.5	----	----	----	----	----	----	----	----	----
50	----	----	----	----	13	20,713	−59.4	----	----	----	----	----	----	----	----	----	5	20,570	−61.3	----	----	----	----	----	----	----	----	----
40	----	----	----	----	10	22,132	−54.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Little Rock, Ark. (1,005.6 mb.)				Mazatlan, Mex. (1,008.2 mb.)				Medford, Oreg. (967.2 mb.)				Merida, Mex. (1,010.0 mb.)				Miami, Fla. (1,016.1 mb.)				Nantucket, Mass. (1,015.6 mb.)				Nashville, Tenn. (995.4mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	79	21.3	76	31	14	25.1	74	31	401	17.5	55	31	27	27.7	67	31	4	24.4	75	31	14	9.9	92	31	177	19.6	76
1,000	31	127	22.1	70	31	86	24.4	74	31	114	(*)	----	31	115	27.0	67	31	144	24.1	74	31	143	12.0	81	31	137	(*)	----
950	31	575	21.1	64	31	544	34.6	33	31	554	17.1	51	31	570	24.9	61	31	593	21.3	72	31	575	12.8	64	31	583	19.8	56
900	31	1,040	18.0	65	31	1,010	24.3	25	31	1,013	13.9	52	31	1,041	21.7	64	31	1,059	18.6	63	31	1,027	10.8	61	31	1,045	16.7	58
850	31	1,527	14.8	63	31	1,507	21.6	27	31	1,492	10.1	57	31	1,535	18.2	67	31	1,547	15.4	63	31	1,502	8.2	58	31	1,529	13.4	59
800	31	2,038	11.6	58	31	2,029	18.5	24	31	1,992	6.3	60	31	2,052	14.7	70	31	2,059	12.2	61	31	2,000	5.7	54	31	2,036	10.0	59
750	31	2,581	9.1	48	31	2,589	15.1	22	31	2,522	2.6	59	31	2,599	11.2	64	31	2,599	9.1	53	31	2,528	2.9	52	31	2,573	6.5	59
700	31	3,144	5.6	44	31	3,159	11.3	23	31	3,073	−.6	56	31	3,169	8.2	52	31	3,166	6.0	46	31	3,081	.0	49	31	3,132	3.1	53
650	31	3,748	1.8	41	31	3,780	7.0	----	31	3,665	−4.1	53	31	3,782	4.8	45	31	3,769	2.5	40	31	3,674	−3.4	43	31	3,733	.0	39
600	31	4,387	−2.4	38	31	4,424	2.3	----	31	4,288	−8.1	47	30	4,425	1.5	33	31	4,412	−1.0	32	31	4,298	−7.1	44	31	4,366	−3.9	33
550	31	5,069	−7.1	35	31	5,125	−2.7	----	31	4,959	−12.5	45	30	5,121	−2.5	----	31	5,101	−5.1	31	31	4,971	−11.4	42	30	5,048	−8.2	30
500	31	5,808	−12.1	32	31	5,871	−8.1	----	31	5,680	−17.1	42	30	5,871	−7.0	----	31	5,843	−9.6	32	30	5,692	−16.3	41	29	5,785	−13.1	32
450	30	6,609	−18.0	----	30	6,692	−13.7	----	31	6,464	−22.9	----	30	6,689	−12.3	----	31	6,657	−15.2	31	30	6,483	−22.0	----	29	6,583	−18.7	----
400	30	4,474	−24.4	----	30	7,567	−20.2	----	31	7,313	−29.5	----	30	7,574	−19.1	----	31	7,529	−21.5	----	30	7,333	−28.3	----	29	7,447	−24.9	----
350	30	8,432	−31.9	----	28	8,546	−27.2	----	31	8,252	−36.6	----	29	8,553	−26.6	----	30	8,498	−28.9	----	28	8,267	−35.4	----	29	8,404	−32.2	----
300	30	9,503	−40.1	----	28	9,638	−35.2	----	30	9,299	−44.9	----	29	9,648	−34.7	----	29	9,581	−37.6	----	28	9,321	−43.3	----	28	9,462	−40.4	----
250	28	10,724	−49.0	----	28	10,883	−44.6	----	30	10,493	−53.4	----	29	10,894	−44.6	----	29	10,813	−47.1	----	23	10,550	−50.9	----	28	10,686	−50.0	----
200	28	12,157	−58.2	----	28	12,339	−55.9	----	29	11,914	−57.7	----	28	12,348	−55.9	----	28	12,254	−57.2	----	16	11,994	−58.5	----	28	12,112	−59.2	----
175	26	12,983	−61.0	----	27	13,176	−61.3	----	29	12,756	−57.3	----	28	13,185	−62.0	----	27	13,093	−61.1	----	14	12,825	−60.2	----	27	12,945	−61.7	----
150	23	13,936	−61.0	----	27	14,121	−66.1	----	27	13,731	−56.0	----	28	14,125	−67.3	----	26	14,046	−63.5	----	12	13,763	−60.2	----	24	13,900	−61.1	----
125	17	15,061	−61.4	----	23	15,215	−68.8	----	23	14,881	−55.9	----	25	15,209	−71.6	----	21	15,163	−66.7	----	6	14,877	−57.9	----	18	15,044	−61.4	----
100	10	16,435	−63.8	----	18	16,530	−73.0	----	18	16,291	−56.7	----	9	16,526	−74.9	----	18	16,505	−70.1	----	----	----	----	----	13	16,418	−63.5	----
80	5	17,842	−66.4	----	14	17,815	−75.6	----	11	17,717	−57.7	----	----	----	----	----	5	17,864	74.1	----	----	----	----	----	8	17,778	−63.8	----
60	----	----	----	----	9	19,520	−68.9	----	5	19,551	−57.6	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	New Orleans, La. (1,015.8 mb.)				North Platte, Nebr. (915.1 mb.)				Oakland, Calif. (1,014.5 mb.)				Oklahoma City, Okla. (967.4 mb.)				Omaha, Nebr. (977.3 mb.)				Phoenix, Ariz. (969.0 mb.)				Pittsburgh, Pa. (972.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	2	22.8	81	31	849	15.1	77	31	6	14.3	73	21	391	20.5	77	31	308	19.1	69	31	339	26.2	22	31	382	15.7	65
1,000	31	139	23.6	75	31	86	(*)	----	31	128	13.3	74	31	102	(*)	----	31	109	(*)	----	31	58	(*)	----	31	139	(*)	----
950	31	593	21.5	63	31	530	(*)	----	31	563	11.9	72	31	551	21.4	69	31	551	17.5	65	31	514	27.6	19	31	583	15.9	55
900	31	1,054	18.5	61	31	990	16.0	70	31	1,011	12.4	55	31	1,016	18.6	68	31	1,010	14.3	70	31	988	23.8	22	31	1,035	13.3	56
850	31	1,542	15.5	57	31	1,475	13.5	64	31	1,489	10.7	48	31	1,504	15.4	67	31	1,492	12.0	69	31	1,482	19.4	25	31	1,513	9.7	60
800	31	2,054	13.0	46	31	1,983	10.6	61	31	1,992	8.2	43	31	2,016	12.8	58	31	1,998	9.5	64	31	1,998	14.8	29	31	2,013	6.4	60
750	31	2,601	10.4	36	31	2,522	7.5	60	31	2,527	5.0	45	31	2,562	9.6	55	31	2,535	6.1	62	31	2,546	10.0	33	31	2,546	3.3	55
700	31	3,166	7.2	34	31	3,082	3.7	57	31	3,082	1.5	44	31	3,125	6.0	50	31	3,092	2.3	60	31	3,106	5.4	33	31	3,100	.3	51
650	31	3,772	3.2	33	31	3,680	−.4	55	30	3,681	−2.2	41	31	3,730	2.0	47	31	3,689	−1.5	54	31	3,710	.9	29	31	3,693	−3.0	45
600	30	4,415	−1.2	33	31	4,315	−5.0	53	30	4,307	−6.4	39	31	4,368	−2.6	46	31	4,320	−6.0	50	31	4,343	−3.5	26	31	4,318	−6.6	44
550	30	5,104	−5.7	32	31	4,993	−9.9	52	30	4,985	−10.7	34	30	5,054	−7.1	44	31	4,998	−10.4	46	31	5,024	−8.4	26	31	4,994	−11.0	38
500	30	5,844	−10.7	----	31	5,721	−14.8	44	29	5,710	−15.8	35	30	5,790	−12.3	40	31	5,724	−15.0	43	31	5,754	−13.7	26	31	5,718	−15.5	32
450	30	6,657	−16.3	----	31	6,515	−20.5	----	29	6,499	−21.5	----	30	6,597	−17.9	34	31	6,519	−20.6	----	31	6,552	−19.6	----	30	6,514	−21.0	----
400	30	7,522	−22.7	----	31	7,370	−27.2	----	29	7,353	−28.2	----	30	7,459	−24.4	----	31	7,374	−27.0	----	31	7,411	−26.5	----	29	7,373	−26.8	----
350	29	8,486	−30.2	----	31	8,317	−34.7	----	29	8,296	−35.3	----	29	8,414	−31.5	----	31	8,322	−34.3	----	31	8,361	−33.6	----	29	8,322	−34.1	----
300	28	9,566	−38.7	----	31	9,374	−43.0	----	29	9,352	−43.0	----	29	9,489	−39.8	----	31	9,382	−42.8	----	31	9,423	−41.7	----	29	9,382	−42.3	----
250	28	10,791	−48.5	----	31	10,576	−52.7	----	29	10,558	−51.1	----	28	10,706	−49.6	----	31	10,585	−52.3	----	31	10,634	−50.4	----	26	10,603	−50.8	----
200	22	12,236	−58.0	----	29	11,993	−60.8	----	29	11,983	−58.3	----	26	12,128	−59.6	----	30	12,001	−59.7	----	31	12,065	−56.9	----	24	12,043	−59.2	----
175	20	13,078	−60.9	----	29	12,823	−60.2	----	29	12,821	−58.6	----	20	12,979	−61.1	----	28	12,834	−61.0	----	31	12,907	−58.4	----	22	12,892	−62.1	----
150	16	14,023	−63.3	----	23	13,791	−59.4	----	29	13,791	−58.0	----	14	13,932	−62.3	----	25	13,797	−59.7	----	29	13,874	−59.3	----	18	13,863	−60.9	----
125	12	15,144	−65.0	----	16	14,950	−60.2	----	28	14,936	−58.6	----	7	15,076	−62.2	----	18	14,933	−59.5	----	28	15,003	−61.3	----	15	14,997	−60.6	----
100	6	16,522	−70.2	----	13	16,345	−62.4	----	25	16,336	−59.3	----	----	----	----	----	10	16,316	−61.0	----	25	16,383	−64.1	----	8	16,396	−61.8	----
80	----	----	----	----	5	17,730	−63.1	----	19	17,729	−60.1	----	----	----	----	----	5	17,711	−61.2	----	15	17,742	−65.9	----	----	----	----	----
60	----	----	----	----	----	----	----	----	12	19,530	−60.1	----	----	----	----	----	----	----	----	----	7	19,478	−62.3	----	----	----	----	----
50	----	----	----	----	----	----	----	----	5	20,651	−58.2	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during May 1949*—Continued

Standard pressure surface (mb.)	Portland, Maine (1,013.3 mb.)				Rapid City, S. Dak. (900.7 mb.)				St. Cloud, Minn. (975.5 mb.)				San Antonio, Tex. (984.9 mb.)				San Juan, P. R. (1,014.5 mb.)				Santa Maria, Calif. (1,005.9 mb.)				Sault Ste. Marie, Mich. (989.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	20	9.9	88	31	980	13.1	70	31	317	14.5	66	31	240	24.0	76	31	15	25.2	82	31	71	13.5	79	31	221	7.8	77
1,000	31	131	11.6	76	31	85	(*)	----	31	105	(*)	----	31	107	(*)	----	31	141	24.6	79	31	121	13.1	78	31	129	(*)	----
950	31	564	11.6	61	31	529	(*)	----	31	546	15.3	55	31	558	22.7	74	31	591	21.5	81	31	557	13.3	60	31	559	9.9	62
900	31	1,011	9.3	60	31	987	(*)	----	31	997	12.4	58	31	1,026	19.8	75	31	1,058	18.6	80	31	1,008	13.5	56	31	1,005	8.3	59
850	31	1,483	6.3	61	31	1,470	13.8	55	31	1,475	9.3	62	31	1,518	17.5	70	31	1,548	15.9	75	31	1,488	11.6	48	31	1,474	5.4	58
800	31	1,978	3.5	62	31	1,978	10.2	57	31	1,975	6.7	59	31	2,034	15.1	59	31	2,061	13.3	65	31	1,992	9.1	45	31	1,976	2.5	57
750	31	2,506	.6	56	31	2,517	6.4	60	31	2,505	3.9	58	31	2,584	13.1	41	31	2,607	11.0	58	31	2,529	6.3	36	31	2,492	−.1	51
700	31	3,050	−2.3	53	31	3,075	2.9	57	31	3,061	.5	56	31	3,157	9.8	35	31	3,177	8.6	46	31	3,086	3.2	38	31	3,036	−3.1	50
650	28	3,642	−5.5	41	31	3,675	−1.2	58	31	3,655	−3.0	54	31	3,767	5.5	34	31	3,789	5.6	37	31	3,683	−.3	36	31	3,625	−6.5	46
600	28	4,260	−9.2	43	31	4,304	−5.6	56	30	4,282	−6.6	49	29	4,417	.6	33	31	4,437	1.8	37	31	4,396	−3.9	34	30	4,241	−10.1	45
550	28	4,933	−13.4	40	30	4,988	−10.3	52	30	4,957	−11.1	46	28	5,106	−4.4	30	31	5,135	−2.4	33	31	4,996	−8.9	31	31	4,910	−14.3	43
500	28	5,647	−18.1	35	30	5,712	−15.1	46	30	5,682	−15.8	41	28	5,854	−9.9	33	31	5,884	−7.2	31	31	5,729	−14.0	30	31	5,623	−18.9	45
450	27	6,427	−23.8	----	30	6,505	−21.0	----	30	6,471	−21.4	----	28	6,661	−15.7	----	31	6,704	−12.7	33	31	6,525	−19.9	----	31	6,408	−24.4	----
400	27	7,268	−30.3	----	30	7,359	−27.5	----	30	7,326	−27.8	----	28	7,537	−22.4	----	31	7,586	−18.9	36	31	7,382	−26.7	----	31	7,281	−30.5	----
350	26	8,205	−37.3	----	29	8,311	−35.3	----	30	8,271	−35.2	----	27	8,503	−29.6	----	29	8,568	−26.1	----	31	8,331	−33.9	----	30	8,182	−37.5	----
300	26	9,260	−45.3	----	29	9,368	−44.0	----	30	9,326	−43.4	----	25	9,584	−37.8	----	29	9,664	−34.3	----	31	9,393	−41.9	----	29	9,228	−45.3	----
250	26	10,454	−53.2	----	28	10,566	−53.0	----	30	10,528	−52.2	----	25	10,815	−47.0	----	29	10,914	−44.3	----	31	10,605	−50.7	----	22	10,463	−51.7	----
200	22	11,881	−59.5	----	26	11,988	−58.9	----	30	11,948	−58.7	----	24	12,265	−56.5	----	28	12,369	−56.1	----	30	12,028	−57.8	----	16	11,924	−58.6	----
175	16	12,716	−60.9	----	25	12,826	−58.8	----	28	12,771	−58.8	----	22	13,103	−60.3	----	26	13,206	−62.4	----	30	12,868	−58.2	----	10	12,759	−59.6	----
150	12	13,672	−59.9	----	21	13,799	−57.4	----	25	13,752	−57.6	----	20	14,064	−62.3	----	25	14,145	−68.7	----	30	13,838	−58.3	----				
125	8	14,784	−58.2	----	19	14,895	−57.0	----	14	15,197	−65.2	----	23	15,224	−73.5	----	29	14,980	−59.9	----				
100					16	14,953	−57.2	----	11	16,318	−57.8	----	5	16,562	−68.3	----	20	16,523	−76.1	----	27	16,372	−62.3	----				
80					8	16,352	−57.4	----									12	17,810	−75.6	----	19	17,739	−62.2	----				
60																					9	19,510	−61.7	----				

Standard pressure	Spokane, Wash. (928.8 mb.)				Swan Island, W. I.[1] (---- mb.)				Tacubaya, Mex. (773.7 mb.)				Tampa, Fla. (1,016.2 mb.)				Tatoosh Island, Wash. (1,012.3 mb.)				Toledo, Ohio (993.1 mb.)				Washington, D. C. (1,014.5 mb.)			
Surface	31	721	17.5	45	----	----	----	----	30	2,306	18.4	51	31	9	23.5	73	31	31	10.7	84	31	191	14.4	75	31	25	17.4	74
1,000	31	83	(*)	----	----	----	----	----	30	36	(*)	----	31	149	23.2	70	31	133	10.6	79	31	131	(*)	----	31	148	17.3	70
950	31	528	(*)	----	----	----	----	----	30	505	(*)	----	31	599	20.9	63	31	568	10.8	62	31	570	14.9	58	31	587	15.7	66
900	31	989	16.6	40	----	----	----	----	30	986	(*)	----	31	1,062	18.0	62	31	1,010	9.3	56	31	1,023	12.3	59	31	1,043	13.2	65
850	31	1,472	12.5	43	----	----	----	----	30	1,486	(*)	----	31	1,549	14.6	61	31	1,481	6.5	54	31	1,500	9.4	59	31	1,522	10.3	65
800	31	1,977	8.0	50	----	----	----	----	30	2,018	(*)	----	31	2,059	11.2	59	31	1,976	3.5	52	31	2,006	6.2	61	31	2,024	7.1	64
750	31	2,509	3.8	53	----	----	----	----	30	2,575	16.7	49	31	2,598	8.2	46	31	2,504	.5	51	31	2,534	3.2	56	31	2,558	3.8	66
700	31	3,062	−.2	55	----	----	----	----	30	3,155	12.3	53	31	3,161	4.8	36	31	3,047	−2.6	48	31	3,084	.3	51	31	3,110	.8	58
650	31	3,655	−4.1	50	----	----	----	----	30	3,778	7.4	59	31	3,764	1.3	32	31	3,637	−6.2	44	31	3,683	−3.1	48	31	3,707	−2.8	53
600	31	4,278	−8.3	48	----	----	----	----	29	4,427	2.5	66	31	4,402	−2.3	----	31	4,253	−10.1	43	31	4,304	−6.8	45	31	4,332	−6.3	50
550	31	4,949	−12.5	46	----	----	----	----	29	5,128	−2.5	68	31	5,089	−6.4	----	31	4,921	−14.3	41	31	4,983	−11.1	38	31	5,009	−10.5	45
500	31	5,669	−17.5	46	----	----	----	----	29	5,876	−7.5	64	31	5,826	−11.2	----	31	5,636	−19.1	41	31	5,703	−16.0	32	31	5,735	−15.1	42
450	31	6,453	−23.6	----	----	----	----	----	29	6,704	−12.0	52	30	6,630	−16.7	----	31	6,417	−24.5	----	31	6,496	−21.7	----	31	6,530	−20.6	----
400	31	7,298	−30.4	----	----	----	----	----	28	7,583	−18.0	43	30	7,499	−23.1	----	31	7,259	−30.6	----	31	7,345	−28.1	----	31	7,384	−26.9	----
350	30	8,229	−37.8	----	----	----	----	----	27	8,565	−25.6	----	30	8,462	−30.6	----	31	8,194	−37.5	----	30	8,287	−35.6	----	30	8,330	−34.2	----
300	30	9,272	−46.0	----	----	----	----	----	24	9,664	−33.8	----	30	9,538	−38.9	----	31	9,240	−45.2	----	30	9,341	−43.9	----	30	9,390	−42.5	----
250	28	10,473	−54.1	----	----	----	----	----	22	10,920	−43.5	----	28	10,762	−48.7	----	31	10,435	−52.8	----	30	10,541	−52.3	----	30	10,597	−50.8	----
200	25	11,881	−58.6	----	----	----	----	----	21	12,383	−55.3	----	28	12,196	−58.2	----	31	11,857	−56.6	----	26	11,957	−58.9	----	30	12,022	−58.6	----
175	20	12,714	−56.2	----	----	----	----	----	19	13,227	−61.5	----	27	13,030	−61.5	----	30	12,705	−55.4	----	24	12,785	−60.1	----	29	12,855	−60.2	----
150	12	13,703	−55.8	----	----	----	----	----	18	14,165	−67.2	----	27	13,981	−63.1	----	27	13,687	−53.7	----	22	13,748	−59.9	----	26	13,807	−59.6	----
125	9	14,859	−55.1	----	----	----	----	----	15	15,259	−71.4	----	25	15,091	−65.7	----	27	14,856	−54.3	----	15	14,912	−60.9	----	23	14,955	−60.1	----
100	6	16,296	−56.6	----	----	----	----	----	9	16,571	−75.2	----	17	16,444	−69.2	----	26	16,283	−54.5	----	11	16,309	−61.9	----	21	16,342	−60.8	----
80					----	----	----	----	5	17,821	−78.2	----	14	17,779	−69.6	----	21	17,708	−54.9	----	5	17,691	−61.2	----	13	17,721	−61.2	----
60					----	----	----	----									14	19,562	−54.4	----					6	19,497	−59.1	----
50					----	----	----	----									10	20,743	−53.7	----								

1 Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

Note.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C. Relative humidity data beginning with October 1, 1948, were computed and expressed in these tables on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

LATE REPORTS OF AEROLOGICAL DATA FOR APRIL 1949

TABLE 1

Standard pressure surface (mb.)	Swan Island, W. I. (1,012.8 mb.)				Standard pressure surface (mb.)	Swan Island, W. I. (1,102.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity		Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	10	26.1	80	450	29	6,715	−10.7	----
1,000	30	122	25.5	80	400	28	7,606	−17.3	----
950	30	577	22.3	83	350	27	8,590	−24.9	----
900	30	1,043	20.0	73	300	27	9,693	−33.4	----
850	30	1,535	17.4	64	250	27	10,948	−42.9	----
800	30	2,051	14.9	55	200	26	12,416	−54.3	----
750	30	2,598	12.6	43	175	26	13,258	−60.9	----
700	30	3,172	9.8	34	150	25	14,203	−66.6	----
650	30	3,787	6.8	----	125	23	15,298	−71.0	----
600	29	4,437	3.5	----	100	19	16,598	−75.1	----
550	29	5,136	−.8	----	80	9	17,875	−76.8	----
500	29	5,892	−5.5	----					

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T., during May 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	155	5.1	31	208	2.4	31	319	1.2	31	315	0.5	30	280	0.4	31	328	3.9	31	130	7.3	31	244	3.3	30	252	1.4	28	149	1.3	31	244	1.5	29	31	0.8	31	213	3.7
500	---	---	---	---	---	---	31	277	1.1	---	---	---	---	---	---	---	---	---	31	144	8.2	31	256	5.9	30	249	2.7	28	152	2.4	31	245	2.3	---	---	---	---	---	---	---	---	---
1,000	31	167	6.7	---	---	---	31	263	2.4	---	---	---	30	273	.6	31	326	4.1	30	159	7.0	31	265	6.9	29	254	4.0	28	248	1.2	30	256	4.1	---	---	---	---	---	---	---	---	---
1,500	31	179	7.5	---	---	---	28	263	3.2	31	274	.9	28	264	1.8	31	312	3.4	24	168	5.5	31	268	7.3	28	264	5.8	28	307	2.8	27	254	4.2	---	---	---	31	218	4.5
2,000	28	193	7.5	31	221	3.8	25	271	4.0	28	247	1.4	27	277	3.2	31	291	2.9	22	164	4.2	29	273	8.6	24	275	8.0	24	315	4.5	26	271	5.6	29	46	1.1	31	219	4.6
2,500	23	204	7.8	31	229	4.5	25	284	5.0	28	253	2.0	26	283	4.4	30	263	2.5	19	161	3.2	26	276	9.4	22	276	10.1	22	313	5.6	23	283	6.4	29	246	.7	31	223	4.5
3,000	22	221	6.6	31	229	5.2	23	292	5.8	26	260	3.9	23	290	7.0	30	234	2.7	17	181	3.3	24	284	11.4	21	277	12.4	21	308	6.3	20	301	7.0	28	197	1.2	31	229	5.9
4,000	20	240	9.0	30	238	7.9	19	289	8.6	19	259	3.6	20	295	10.1	26	195	3.5	15	228	2.9	22	285	13.7	18	279	14.7	21	301	7.6	15	305	8.0	22	244	7.4	31	241	9.0
5,000	17	258	10.3	29	245	10.6	13	290	11.9	17	265	5.7	13	290	9.8	21	204	1.7	13	274	4.6	15	287	14.2	15	282	17.7	18	292	8.7	12	312	8.7	17	249	10.5	29	245	13.4
6,000	15	271	13.3	27	248	14.4	10	296	10.6	14	250	6.5	---	---	---	17	235	1.7	11	269	6.2	---	---	---	11	277	18.6	17	295	9.8	12	308	8.4	12	258	11.8	27	246	14.7
8,000	---	---	---	23	256	18.1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	283	10.0	---	---	---	---	---	---	24	253	20.4
10,000	---	---	---	17	253	21.9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	246	24.1
12,000	---	---	---	10	258	27.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (11 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
Surface	31	194	1.9	31	230	1.8	29	214	0.6	29	298	0.7	30	65	2.3	30	250	1.5	31	199	2.8	30	188	1.6	31	288	1.2	30	100	3.3	31	211	2.2	31	297	0.6	30	194	0.7
500	---	---	---	---	---	---	29	220	1.1	---	---	---	30	44	1.0	30	271	1.4	---	---	---	30	202	2.4	31	288	1.4	30	105	4.1	31	217	2.5	31	264	1.0	30	250	2.3
1,000	---	---	---	---	---	---	29	227	1.8	29	304	1.6	29	328	1.3	28	246	3.1	31	195	3.8	29	211	3.4	31	278	1.7	30	85	2.1	27	258	1.5	29	239	2.1	30	274	3.7
1,500	---	---	---	31	233	2.0	27	259	3.3	29	277	1.2	28	293	2.5	25	241	4.6	31	202	4.0	26	230	2.8	31	263	1.1	30	8	3.0	25	278	1.8	29	256	2.9	29	284	5.0
2,000	31	194	2.1	31	243	2.6	27	288	5.1	27	259	2.3	25	297	3.0	25	255	6.5	30	207	4.9	25	240	3.0	26	192	.7	29	349	2.7	20	333	1.8	27	273	4.2	27	291	6.8
2,500	31	183	3.1	31	231	2.8	27	297	6.6	26	253	3.0	24	299	4.1	23	279	7.5	29	208	5.1	21	253	4.2	24	182	1.5	23	323	2.8	17	360	3.1	24	279	5.2	26	296	7.6
3,000	30	197	3.0	31	231	3.9	25	295	7.0	22	263	5.0	23	313	5.1	18	289	9.4	28	214	5.0	17	252	5.1	23	195	1.3	21	337	3.6	14	357	2.9	23	279	5.6	22	298	9.0
4,000	21	214	5.0	28	226	4.8	22	303	6.7	12	271	7.1	20	327	6.3	15	289	10.1	27	240	5.6	---	---	---	18	252	.4	19	317	2.3	14	318	3.5	21	282	6.6	10	288	8.6
5,000	18	235	6.6	23	230	6.8	17	307	6.3	11	267	6.1	17	317	8.1	---	---	---	26	238	8.0	---	---	---	15	281	1.7	13	295	4.2	10	325	5.4	15	298	5.8	---	---	---
6,000	15	251	9.2	21	249	5.3	12	306	7.9	---	---	---	15	315	9.5	---	---	---	22	249	10.8	---	---	---	14	303	3.6	---	---	---	---	---	---	12	298	5.3	---	---	---
8,000	---	---	---	12	263	8.4	---	---	---	---	---	---	11	301	8.8	---	---	---	16	252	17.2	---	---	---	11	267	8.7	---	---	---	---	---	---	---	---	---	---	---	---
10,000	---	---	---	---	---	---	---	---	---	---	---	---	11	304	14.3	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	265	6.3	31	168	4.3	30	184	2.0	31	232	1.5	31	117	0.9	31	224	1.9	31	190	1.8	30	135	3.8	31	259	3.7	31	307	3.4	30	260	1.9	30	233	2.0	30	224	1.0
500	31	274	5.1	31	173	4.6	30	189	2.6	31	232	2.0	---	---	---	31	222	1.9	31	212	2.1	30	148	5.0	31	256	2.9	31	284	3.8	30	284	1.7	---	---	---	30	236	2.0
1,000	25	296	3.1	31	189	5.1	29	195	3.9	31	233	2.3	31	132	.8	30	217	2.7	30	222	3.9	29	152	4.9	23	274	1.9	29	270	5.0	27	270	.9	30	228	2.4	30	252	3.0
1,500	25	288	3.3	29	209	5.8	25	213	5.9	31	221	2.4	31	250	1.5	25	244	3.7	28	234	5.6	27	155	5.2	22	264	2.5	26	268	4.7	27	200	1.0	30	223	2.5	29	269	4.2
2,000	25	293	2.7	26	221	7.1	23	234	5.8	31	216	3.7	29	256	2.1	21	280	5.4	27	252	5.3	25	175	5.2	21	267	2.2	26	282	5.8	24	243	1.4	26	227	2.7	25	277	5.7
2,500	23	289	3.3	22	241	7.1	14	275	3.7	31	213	5.1	26	269	2.3	18	281	7.5	27	268	6.6	20	200	3.5	19	280	2.4	23	294	7.8	23	208	1.7	23	224	2.4	23	297	8.1
3,000	21	282	3.8	20	243	7.4	12	285	3.9	31	218	6.2	24	272	4.0	16	286	10.9	22	282	7.3	15	263	3.2	19	271	4.3	22	302	9.0	22	206	3.1	19	215	3.5	22	303	9.6
4,000	21	275	6.4	18	256	10.7	---	---	---	29	238	8.4	24	286	5.4	12	302	11.5	16	304	6.5	11	286	4.5	19	276	7.9	19	301	12.6	16	250	3.9	18	240	4.4	19	295	10.8
5,000	21	279	9.5	15	262	11.5	---	---	---	28	248	10.4	21	274	7.2	10	298	12.4	12	316	8.3	---	---	---	18	277	9.6	19	303	14.8	16	234	4.4	14	240	5.0	18	306	10.9
6,000	21	280	12.3	---	---	---	---	---	---	23	253	12.9	18	276	9.8	---	---	---	10	306	8.7	---	---	---	17	271	10.6	15	308	18.4	16	238	6.0	11	233	4.7	16	287	11.7
8,000	16	295	13.8	---	---	---	---	---	---	16	267	14.8	12	283	12.8	---	---	---	---	---	---	---	---	---	14	264	13.7	---	---	---	10	252	2.9	---	---	---	10	299	6.2
10,000	11	290	13.2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T., during May 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)			Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Medford, Oreg. (401 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	164	0.9	31	141	4.7	31	49	2.1	31	129	5.4	31	250	1.0	31	157	0.4	31	132	1.6	31	104	1.4	31	80	0.6	31	117	0.9	31	103	0.6	31	172	0.7	31	322	2.4
500										31	140	9.3	31	260	3.5	30	192	2.8	31	167	3.3				31	198	1.1	31	195	1.3	30	136	1.2	30	173	3.7	31	314	2.8
1,000				31	157	8.5	31	149	1.1	31	159	7.9	31	277	5.1	31	249	1.8	31	199	4.4				31	238	2.4	31	241	2.2	30	227	1.7	29	202	4.1	31	306	3.5
1,500				31	180	8.9	31	316	1.6	31	152	7.2	30	289	6.7	31	297	2.4	30	228	5.1	31	106	1.4	31	261	3.7	31	251	2.3	29	257	4.0	29	221	3.6	31	316	2.3
2,000	31	249	2.9	31	202	6.9	31	303	3.6	31	162	5.6	30	283	8.0	31	316	2.8	30	253	5.6	31	183	2.4	31	277	4.0	31	274	2.6	29	272	5.2	29	233	3.8	31	313	2.1
2,500	31	247	4.9	31	221	6.2	31	303	4.9	31	169	3.9	30	277	9.2	31	307	2.9	28	261	5.2	31	206	4.1	31	290	4.6	31	280	2.9	30	291	6.6	29	241	4.4	31	254	2.7
3,000	31	246	6.7	31	237	6.4	30	282	5.7	31	174	2.6	30	281	10.9	30	314	3.7	28	264	6.0	31	215	4.0	31	298	5.7	31	281	3.6	31	305	8.7	29	253	5.4	31	247	3.0
4,000	31	245	8.9	31	260	7.8	30	302	8.4	30	274	1.6	30	274	13.4	29	307	5.2	28	277	6.7	30	235	4.9	30	303	6.8	30	283	4.0	31	287	10.0	29	273	7.7	31	253	3.5
5,000	31	241	10.9	31	267	8.5	30	287	8.5	30	288	4.2	28	269	15.4	28	306	5.5	26	276	8.0	30	247	6.4	29	299	8.0	28	291	5.5	30	283	11.5	30	272	8.4	30	254	4.2
6,000	31	251	12.1	31	259	10.4	30	290	10.6	30	293	5.4	27	263	18.1	28	305	6.9	26	275	8.9	30	245	8.7	29	293	8.6	28	283	7.2	30	277	13.0	30	270	10.1	29	253	4.5
8,000	29	256	15.9	30	262	16.0	29	279	11.1	30	282	10.9	20	256	18.1	27	298	8.3	24	277	11.1	25	244	7.8	28	288	11.0	25	280	6.0	28	294	16.9	29	268	13.1	27	227	4.8
10,000	22	263	19.4	26	264	20.0	27	284	11.7	30	281	19.2	12	267	18.1	23	290	9.0	23	269	12.5	20	265	7.3	25	280	9.6	22	274	7.2	20	286	20.3	25	271	15.2	23	252	6.6
12,000	16	260	20.3	22	258	24.4	21	285	12.7	24	283	27.9				17	289	12.4	19	275	15.9	14	257	13.7	19	287	13.0	20	266	8.3	12	287	23.9	21	261	16.1	16	263	6.9
14,000				15	265	24.6	12	256	12.3	12	272	23.3				10	286	11.7							10	291	11.0	18	271	8.6				16	275	17.1	11	274	9.6
16,000																													12	269	10.5								

Altitude (meters) m. s. l.	Miami, Fla. (12 m.)			Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			San Antonio, Tex. (242 m.)			San Juan, P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	81	1.0	29	213	1.7	31	139	0.3	31	148	1.3	31	271	6.1	31	140	3.9	31	273	0.4	31	120	4.5	31	123	3.2	31	117	0.9	31	275	3.5	31	308	1.2	31	219	1.4
500	31	96	3.3	29	259	4.2	30	206	.9	31	164	3.2	31	279	5.0	30	149	5.4				31	140	7.7	31	109	7.4	30	87	.9	31	311	3.6	31	285	1.8						
1,000	31	82	3.6	29	291	4.1	30	247	2.1	31	152	1.6	31	284	4.4	30	179	7.8	31	282	.3	31	151	8.7	31	106	7.1	30	212	3.9	31	318	2.8	31	280	2.9	31	225	2.4
1,500	31	55	3.2	29	291	4.5	30	260	3.0	31	144	.6	31	296	3.4	29	202	7.2	31	184	.7	31	166	6.4	31	105	6.1	29	241	4.5	31	333	2.5	31	297	4.3	31	249	2.6
2,000	31	36	3.1	28	282	5.2	30	264	3.8	31	310	1.1	31	309	3.3	30	223	6.7	31	247	1.2	31	186	4.5	31	98	5.0	29	261	5.9	31	328	2.4	31	282	5.3	31	260	2.3
2,500	31	27	3.0	27	271	5.7	31	279	5.0	30	281	1.8	31	321	3.5	30	238	6.7	31	272	2.1	31	205	4.5	31	96	5.0	29	269	6.8	31	320	3.1	30	289	7.2	30	263	1.6
3,000	31	18	2.4	27	266	6.9	31	283	5.8	30	292	2.6	31	315	3.4	31	247	7.7	31	288	3.2	31	229	4.9	31	92	4.6	30	276	7.5	31	302	4.5	30	291	8.5	30	260	2.1
4,000	31	325	2.2	29	265	9.3	31	289	7.5	31	301	5.0	30	297	3.7	31	262	9.1	29	268	4.2	30	259	5.6	31	92	3.1	30	288	8.9	31	294	6.9	29	291	10.9	29	257	4.4
5,000	31	300	4.6	27	261	11.4	31	293	8.8	30	303	7.0	30	288	5.3	30	263	9.9	29	271	4.8	29	267	7.3	30	141	1.7	30	285	10.7	31	281	9.1	29	296	13.2	29	253	4.6
6,000	31	288	6.1	25	263	13.7	29	292	10.1	30	295	8.2	29	285	6.6	30	272	11.9	28	269	6.6	29	273	9.0	30	233	2.5	29	282	10.9	31	280	10.6	28	299	15.6	29	245	5.4
8,000	31	280	10.9	16	256	17.7	28	287	12.9	30	289	10.7	28	290	8.8	28	258	14.3	27	271	7.0	28	276	13.7	30	256	8.6	28	278	14.9	30	281	14.2	23	294	17.4	28	230	7.3
10,000	29	272	12.5	11	250	22.9	25	287	14.1	28	286	16.5	27	286	11.2	27	257	13.9	26	252	13.2	24	279	22.2	29	259	14.7	26	284	14.0	28	271	16.4	19	284	16.5	23	241	8.9
12,000	27	269	17.4				22	278	15.9	21	297	25.3	24	291	15.5				21	259	14.4	17	274	27.9	27	267	21.7	24	279	12.9	26	272	18.1				16	268	7.6
14,000	25	280	17.9				16	290	16.6	12	288	24.6	15	262	11.3				17	268	10.9	12	277	24.6	24	270	21.0	16	268	13.3	24	264	16.8						
16,000	19	285	11.4				11	309	11.2																20	273	12.2				22	254	12.4						
18,000																									10	155	2.0				14	247	7.0						

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 mi.)		
	Observations	Direction	Speed
Surface	31	200	1.8
500	31	250	2.0
1,000	31	219	1.5
1,500	31	211	2.3
2,000	31	212	3.1
2,500	31	217	3.6
3,000	30	236	4.0
4,000	31	239	6.0
5,000	30	241	8.0
6,000	30	244	9.4
8,000	28	241	10.8
10,000	25	227	10.4
12,000	20	241	8.7
14,000	18	257	7.2
16,000	18	258	7.4
18,000	13	267	1.4

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following Table III in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR MAY 1949

The most damaging floods during the month occurred in the Upper Trinity at Fort Worth, Tex. It was the worst flood on record for that city. Severe damage also occurred in the Arkansas Basin in Oklahoma from the record to near record floods.

Atlantic Slope Drainage.—Considerable rainfall in Maine during the last decade of May brought the river flow to near normal and the reservoir storage to about 85 percent of normal. In New Hampshire the streamflow was somewhat below normal even though the rainfall for the month was above normal, as the snow melted well in advance of the normal date due to the early spring.

There were no major rises in the Delaware River Basin during the month even though the precipitation averaged nearly twice normal. Minor rises occurred on the 22–23rd on the Perkiomen and Brandywine Creeks. Rises of 3 to 4 feet occurred in the West Branch of the Susquehanna in Pennsylvania from the heavy rains on the 19th and 20th which averaged more than 2.5 inches.

Near bank-full stages occurred in the Upper Rappahannock at Remington, Va., due to the heavy rain on the 2d and 3d. The precipitation over the Rappahannock Basin during this storm averaged 1.2 inches.

Heavy rain occurred over the headwaters of the Roanoke on the last day of April and on May 16th causing rapid rises to above flood stage at Altavista, Va., on May 2d and 17th. No flooding occurred at other points as the crest flattened out as it moved downstream. Heavy showers occurred over most of eastern North Carolina on the 10th and 11th with the heaviest showers (over 4 inches) in the Raleigh area, causing high stages on the Neuse River below Neuse, N. C. Flooding also resulted on the Roanoke and lower Cape Fear Rivers. Some pasture and crop damage resulted from the inundation along the Neuse.

Heavy rains occurred in the Yadkin and Santee River Basins and light to moderate rains in the Pee Dee Valley in South Carolina on the 1st causing light flooding along several streams. No damage was reported but there was considerable loss in wages due to interruption of lumbering activities.

Heavy to excessive rains from April 28 through May 2d caused light flooding in several streams in Georgia. The rainfall averaged 3.85 inches in the Savannah drainage area above Augusta and 2.97 inches in the Ogeechee drainage. No damage of consequence resulted.

East Gulf of Mexico drainage.—Heavy rains occurred in the East Gulf of Mexico drainage during the last three days of April and the first two days of May and caused light to moderate flooding in streams in the area. Some damage resulted to growing crops and the loss in wages due to the interruption of gravel dredging and logging operations.

Missouri Basin.—Local minor overflows occurred on the Upper Republican, Solomon and Blue Rivers during the beginning and ending of the month. During the latter period there was also some light local overflow on the lower Marais des Cygnes. The first overflows were the result of moderate rains on the 5th and 6th (0.75 inch in Upper Blue and Solomon to slightly over an inch over much of the Republican) followed by heavy rains on the 7th and 8th (nearly 2 inches in the Upper Republican and Upper Blue and 1 inch in Upper Solomon.)

Light flooding resulted on the North Fork of the Elkhorn at Pierce, Nebr., from the heavy rain on the 20th and 21st. The heaviest rains were reported in the Wausa-Osmond-Pierce area averaging from 4 to 4.5 inches during the 18-hour period ending at noon on the 21st. The remainder of the North Fork Valley received from 1.5 to nearly 3 inches.

Ohio Basin.—Heavy thundershowers over the upper portion of the Wabash River on the 21st caused sharp rises to above bank-full stages from Wabash to Terre Haute, Ind. Additional rain occurred on the 22d and 23d. The total rainfall during the period was as follows: Logansport, 5 inches; Peru and Monticello, 4 inches; Wabash and Rochester, 3 inches; and La Fayette, Covington and Terre Haute, 2 inches. Some damage resulted to growing crops at La Fayette and Covington.

Arkansas Basin.—There was considerable flooding in the Arkansas Basin during May with most of it occurring in Oklahoma. The maximum stage of record occurred on the South Fork at Alva and on Medicine Lodge River at Kiowa, Okla. Severe flooding of near-record proportions occurred along the Cimarron. The crest of 15.0 feet at Perkins, Okla., was the highest since October 5, 1926, when the maximum stage of 17 feet was reached. The crest on Cottonwood Creek at Guthrie, Okla., was 2 feet higher than the maximum of record established in 1897 and on the Cimarron at the same point it was the third highest of record. Minor to moderate flooding occurred along the Arkansas from Fort Smith to Morrilton, Ark. The severe flooding was due to heavy to excessive rains on the 1st, 7th, and 16th to 26th ranging from 5 to 10 inches. Severe damages resulted from the flooding.

Red, Lower Mississippi, and Atchafalaya Basins.—Scattered heavy showers occurred over the Sulphur in the Red Basin on April 28th and 29th (2.5 inches at Mount Pleasant, Tex.) causing light to moderate flooding below Hagansport, Tex. Only minor flooding resulted on the lower White River in Arkansas from the moderate to heavy showers with excessive rains of 5 inches in the extreme upper portion of the basin.

The Yazoo River in the Lower Mississippi Basin remained above flood stage at Yazoo City, Miss., until the 18th. It was 5 feet below flood stage at the end of the month.

Flooding along the Atchafalaya at Morgan City, La., was due to wind and tide effects.

West Gulf of Mexico drainage.—Light flooding occurred in the upper Sabine at Mineola, Tex., in the beginning of the month due to heavy rains (2 inches) on April 26 and 29. Heavy rains on the 17th caused additional flooding at this point. No damage of consequence resulted.

The flooding which resulted in Fort Worth, Tex., from heavy thundershowers on the 16th and 17th and levee breaks was the worst on record. The heaviest rains occurred over South Fort Worth with 10 inches reported in the Meadowbrook section. The rainfall averaged 4.17 inches over the Upper Trinity above Rosser, Tex. No information was available on the actual gage heights during the critical stage of the flood as the river gage was washed away early on the 17th. The crest of 25.9 feet later determined was 1.9 feet higher than the previous record crest of 24.0 feet in April 1932.

The crest at Dallas of 46.9 feet was the second highest of record. It was exceeded only by the flood of May 25, 1908, when a crest stage of 52.6 feet was reached. The only other comparable flood which has occurred on the Trinity in Dallas was in 1942, when a crest of 45.75 feet was reached on April 26.

The crest flattened out considerably as it moved downstream and no record stages were reached in the Trinity below Dallas.

Most major floods in the Upper Trinity have been caused by a series of rainstorms over a period of several

days, whereas this flood was caused by heavy thundershowers which occurred within a 24-hour period. In April 1942, run-off from four separate rainstorms over a period of 20 days moved through the channel before reaching a flood stage of 45.75 feet at the Dallas gage.

The greatest damage to urban property occurred in Fort Worth. Extensive damage was done to a national retail and mail order house in that city, numerous used and new car dealers, thousands of residences, levees, city streets, water plant and other public utilities. Much of Fort Worth was without water in the city mains for a period of about 3 days. Severe flooding occurred along the lowlands outside of the Dallas levee district, and several sections of South Dallas, unprotected by levees, were inundated. However, most of Dallas escaped damage from the flood due to protection afforded by the levee system. Levee breaks were reported near Rosser, which caused some flooding of farm lands. Damage to growing crops was greatest along the main river channel between Fort Worth and Rosser. At least 10 people are known to have lost their lives as a result of this flood in the Fort Worth area.

A major flood occurred in the upper Brazos at Lubbock, Tex., due to heavy rains (5 inches) on the 6th and 7th. Approximately 350 homes and businesses were flooded in the area. Many residents had to be evacuated by rescue boats. Damages were moderate.

Columbia Basin.—The Snake River and tributaries rose steadily during May until crests were reached during the latter part of the middle decade except for minor recessions from the 4th to the 8th. No flooding occurred except on the Clearwater at Kamiah, Idaho, whose crest of 15.8 feet was 3.4 feet lower than during 1948.

Snowfall was unusually heavy during the early winter months in the Columbia River Basin above the Grand Coulee Dam. At Spokane, Wash., a record snowfall of 33 inches occurred during the month of December while for the season as a whole more than 70 inches were measured which is twice normal and one of the heaviest falls of record. By the first of March the mountain snowpack ranged from 25 to as much as 75 percent above average in the headwaters of the Clark, Flathead, Kootenai and Spokane Rivers. All streams were low in the beginning of April but rose gradually throughout the month. An unseasonable heat wave during the second week of May was accompanied by summerlike temperatures which greatly accelerated snow melting and stream flows. The Kootenai at Bonners Ferry, Idaho, rose from 12.4 feet on the 8th to 30.9 feet on the 16th, 0.1 foot below flood stage. Cooler weather on the 15th checked the rapid snow melt, with falling stages occurring in all streams shortly. Several streams reached or slightly exceeded flood stage but little or no damage occurred as the overflow was mostly on low range land or pasture land. The dikes which protect more than 30,000 acres of rich fertile wheat lands held and the only loss resulted when the waters topped one dike and inundated some 300 acres of wheat land.

The flooding at Jefferson, Oreg., on the Santiam River and at Harrisburg, Oreg., on the Willamette River in the beginning of the month was due to moderately heavy scattered rain supplemented by some snow melt. This freshet was the largest of any that has been recorded so late in the season. These floods are usually past by the middle of April. Damages consisted almost entirely of loss to prospective crops and erosion. The losses resulting from the annual flood in progress in the Columbia Basin at the close of the month were confined to flooding of pasture lands and erosion. Lower docks in the harbor along the lower Columbia and lower Willamette were evacuated well in advance of the occurrence of flood stages.

FLOOD STAGE REPORT FOR MAY 1949

[All dates in May unless otherwise specified.]

River and station	Flood stage	Above flood stage—dates		Crest[1]	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Erie	Feet			Feet	
St. Marys: Decatur, Ind.	13	22	22	15.1	22
Maumee: Fort Wayne, Ind.	15	22	23	15.8	23
ATLANTIC SLOPE DRAINAGE					
Roanoke:					
Alta Vista, Va.	10	2	3	16.0	3
		11	12	15.6	11
Weldon, N. C.	31	17	17	10.3	17
		12	13	33.3	13
Scotland Neck, N. C.	28	12	15	28.6	14
Williamston, N. C.	10	6	27	10.8	9
				11.1	18-20
Neuse:					
Neuse, N. C.	14	13	13	14.0	13
Smithfield, N. C.	13	11	14	17.7	13
Goldsboro, N. C.	14	13	19	18.0	17
Kinston, N. C.	14	17	21	15.7	20
Cape Fear: Lock No. 2, Elizabethtown, N. C.	20	4	6	24.1	4
		12	15	26.2	13
Lynches: Effingham, S. C.	14	6	8	14.7	7
Pee Dee:					
Cheraw, S. C.	30	2	5	36.5	2
Pee Dee, S. C.	19	3	18	23.5	8
Saluda: Pelzer, S. C.	6	Apr. 30	6	8.6	2
Broad:					
Blairs, S. C.	14	1	4	15.0	2
				15.4	3
Carlton, Ga.	15	1	2	15.8	1
Savannah: Butler Creek, Ga.	21	1	4	23.5	3
Ocmulgee:					
Macon, Ga.	18	2	2	18.6	2
Abbeville, Ga.	11	6	10	12.2	8
Oconee: Milledgeville, Ga.	20	1	1	20.5	1
Altamaha: Charlotte, Ga.	12	7	16	15.1	12
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee: Eufaula, Ala.	40	1	2	43.4	2
Flint: Albany, Ga.	20	5	6	21.3	5
Apalachicola:					
Chattahoochee, Fla.	20	4	5	20.9	4
Blountstown, Fla.	15	1	17	21.5	6
Choctawhatchee: Caryville, Fla.	12	3	5	12.2	4
Cahaba: Centerville, Ala.	23	2	2	23.7	2
Alabama:					
Montgomery, Ala.	35	2	5	40.0	3
Millers Ferry, Ala.	40	3	9	47.0	6
Black Warrior:					
Tuscaloosa Lock and Dam, Ala.	47	2	3	48.3	3
Lock No. 7, Eutaw, Ala.	35	3	7	41.5	5
Tombigbee:					
Lock No. 4, Demopolis, Ala.	39	3	10	49.6	7
Lock No. 3	33	2	12	51.4	7
Lock No. 2	46	3	11	52.4	8
Lock No. 1	31	3	14	35.4	10-11
Sowashee Creek: Meridian, Miss.	15	2	2	15.7	2
Chickasawhay:					
Enterprise, Miss.	20	3	5	21.5	4
Shubuta, Miss.	30	4	5	30.5	5
Pascagoula: Merrill, Miss.	22	4	9	22.9	7
Bogue Chitto: Franklinton, La.	11	2	3	13.5	3
Pearl:					
Edinburg, Miss.	20	4	8	22.4	5
Jackson, Miss.	18	2	16	26.7	9
Monticello, Miss.	15	2	6	17.0	3
Pearl River, La.	12	1	14	15.7	5
		15	23		
MISSISSIPPI SYSTEM					
Missouri Basin					
Solomon: Beloit, Kans.	18	10	10	18.0	10
		22	23	20.0	22
Little Blue:					
Endicott, Nebr.	9	10	11	9.3	11
		21	24	14.2	22
Hanover, Kans.	14	22	23	17.2	23
Big Blue:					
Beatrice, Nebr.	16	23	23	16.8	23
Barnston, Nebr.	18	9	9	20.0	9
		23	24	19.2	23
Blue Rapids, Kans.	20	23	24	21.1	23
North Fork: Pierce (near), Nebr.	12	21	23	13.5	21
Republican:		8	9	5.5	8
Cambridge, Nebr.	5	13	13	5.3	13
		15	15	5.0	15
		21	21	5.1	21
		22	22	5.3	22
Clay Center, Kans.	15	22	22	15.6	22
Marais des Cygnes: LaCygne, Kans.	25	22	22	25.8	22

See footnotes at end of table.

FLOOD STAGE REPORT FOR MAY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest[1]	
		From—	To—	Stage	Date
Ohio Basin					
Wabash:					
Wabash, Ind.	12	22	23	14.0	22
LaFayette, Ind.	11	23	25	15.1	23
Covington, Ind.	16	24	26	18.4	25
Terre Haute, Ind.	14	26	28	14.7	27
Arkansas Basin					
Little Arkansas:					
Sedgwick, Kans.	18	1	1	23.0	1
		17	17	18.7	17
Ripley, Kans.	11	1	2	12.2	1
				15.0	19
Cimarron:				14.4	20
Perkins, Okla.	11	17	25	14.2	22
				12.6	24
				11.6	25
Mannford, Okla.	18	19	21	23.7	19
				19.1	21
Bird Creek: Sperry, Okla.	21	19	21	26.6	20
Verdigris:					
Claremore, Okla.	38	21	22	38.6	22
Inola, Okla.	41.5	20	26	46.5	23
Neosho: Emporia, Kans.	22	22	22	24.5	22
		8	12	19.2	9
Deep Fork: Dewar, Okla.	18			21.6	19
		18	[2]	22.7	22
				23.1	25
North Canadian:					
Woodward, Okla.	5	17	17	6.0	17
Yukon, Okla.	11	18	22	15.0	19
Wetumka, Okla.	14	18	19	17.8	18
Canadian:					
Union, Okla.	7	19	19	7.6	19
		21	21	7.0	21
Calvin, Okla.	15	18	18	15.5	18
Whitefield, Okla.	16	19	19	18.8	19
Arkansas:					
Fort Smith, Ark.	22	19	30	28.6	22
				25.8	25
Van Buren, Ark.	22	19	31	29.0	22
				26.6	25
Ozark, Ark.	22	21	24	25.6	22
Dardanelle, Ark.	22	22	30	27.1	23
Morrilton, Ark.	30	23	24	31.0	24
Red Basin					
Ouachita:					
Arkadelphia, Ark.	17	2	4	21.5	3
Camden, Ark.	26	4	8	29.8	6
Little:					
Horatio, Ark.				30.5	3
Whitecliffs, Ark.	25	5	7	26.4	6
Sulphur:					
Hagansport, Tex.	38	Apr. 30	2	40.9	Apr. 30
		18	18	40.0	18
Naples, Tex.	22	2	8	26.4	4
McCartney Bridge, Tex.				22.9	11

FLOOD STAGE REPORT FOR MAY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest[1]	
		From—	To—	Stage	Date
Lower Mississippi Basin					
				36.2	Feb. 10
Yazoo: Yazoo City, Miss.	29	Jan. 3	18	33.4	Apr. 18
				32.8	18
Atchafalaya Basin					
Atchafalaya: Morgan City, La.	[3]6	Feb. 18	3	8.0	Mar. 21
WEST GULF OF MEXICO DRAINAGE					
Sabine: Mineola, Tex.	14	4	5	14.7	5
		22	25	16.6	23
West Fork: Fort Worth, Tex.	17	17	17	25.9	17
Elm Fork: Carrollton, Tex.	6	17	19	10.7	18
East Fork: Rockwall, Tex.	10	17	20	15.0	17
Trinity:					
Dallas, Tex.	28	17	21	46.9	18
		26	June 1	34.2	28
Rosser, Tex.	26	19	June 4	38.0	21
Trinidad, Tex.	28	21	June 7	41.5	23
Long Lake, Tex.	40	28	[2]	41.5	30
Brazos:					
Rainbow, Tex.	20	16	18	27.8	17
Waco, Tex.	27	18	18	27.3	18
GULF OF CALIFORNIA DRAINAGE					
Colorado Basin					
		Apr. 24	Apr. 27	4.5	Apr. 26
		Apr. 29	6	4.8	3
Animas: Durango, Colo.	4	11	20	4.9	16
		23	[2]	5.5	28
PACIFIC SLOPE DRAINAGE					
Columbia Basin					
Flathead: Columbia Falls, Mont.	13.2	12	18	14.8	15
Coeur d'Alene: Cataldo, Idaho	40	1	5	41.0	
		8	18	42.8	13
St. Joe: St. Maries, Idaho	35	11	20	36.7	16
Coeur d'Alene Lake: Coeur d'Alene, Idaho	30	1	[2]	34.5	17
Spokane: Spokane, Wash.	27	17	19	27.1	17-18
Clearwater: Kamiah, Idaho	14	12	18	15.8	15-16
McKenzie: Leaburg, Oreg.	12	2	2	16.0	2
Santiam: Jefferson, Oreg.	13	1	3	18.5	2
Willamette:					
Harrisburg, Oreg.	12	2	3	14.9	2
Portland, Oreg.	18	14	[2]	22.2	19
Columbia: Vancouver, Wash.	15	3	7	15.5	5
		1	[2]	22.5	18

[1] Provisional.
[2] Continued at end of month.
[3] Flood stage or higher reached intermittently.

CLIMATOLOGICAL DATA FOR MAY 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1948, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature							Precipitation					
			Monthly extremes							Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	72.9	+1.6	Dothan CAA Airport	98	21	Gadsden	45	26	4.07	+0.12	Citronelle	8.63	Geneva	0.82
Arizona	65.2	−.5	Gila Bend	110	26	2 stations	18	[1] 7	.29	−.03	Burrus Ranch	1.43	55 stations	.00
Arkansas	71.3	+2.2	2 stations	94	31	Corning	30	3	5.29	+.23	Ozark	11.58	Crystal Valley	.85
California	62.4	−.7	Greenland Ranch	114	26	Twin Lakes	16	9	1.08	+.28	Gasquet R. S.	7.85	22 stations	.00
Colorado	53.5	+1.0	3 stations	96	[1] 3	Dillon	14	1	2.43	+.53	Ft. Lupton	7.46	Manassa	.27
Florida	76.5	+.9	5 stations	98	[1] 22	2 stations	57	[1] 13	2.34	−1.57	Royal Palm R. S.	8.93	Carrabelle	T
Georgia	72.6	+.5	3 stations	96	[1] 8	Blairsville Exp. Sta.	38	26	3.50	+.07	Greensboro	10.91	Doles	.62
Idaho	56.5	+3.3	Weiser	97	26	Grouse	17	[1] 4	2.02	+.33	Chilly, 4 SE (Barton F.).	4.50	Grand View	.03
Illinois	65.1	+2.4	Carlyle	96	22	3 stations	30	11	2.77	−1.35	Edwardsville	6.13	Marengo	.62
Indiana	63.6	+1.4	Fowler Power Substa.	97	6	HoweMilitarySchool	28	11	3.36	−.74	Logansport	7.50	Brookville, 1 S.	1.34
Iowa	63.5	+3.1	Onawa	95	3	Emmetsburg	28	9	2.68	−1.28	Sioux Rapids	5.58	Monmouth	.92
Kansas	65.8	+2.1	2 stations	98	3	Ulysses	35	2	5.34	+1.58	Eskridge	10.20	Lakin	2.06
Kentucky	66.3	+1.0	Campbellsville	95	5	2 stations	36	[1] 27	2.78	−1.18	Loglick, 1 S.	5.27	Tompkinsville Tel Off.	.91
Louisiana	76.2	+2.4	2 stations	97	[1] 6	Pollock	44	12	2.35	−2.33	Kentwood	11.24	Harmon	.17
Maryland-Delaware.	63.5	+.5	Westernport, Md.	96	[1] 5	Cumberland Police Brks, Md.	28	29	4.77	+1.11	Charlotte Hall, Md.	8.79	Picardy, Md.	2.28
Michigan	56.1	+2.0	2 stations	94	[1] 3	Kenton U. S. Forest	16	10	2.75	−.54	Dowagiac, 2 E.	6.54	East Tawas U. S. Forest.	.85
Minnesota	57.6	+2.5	3 stations	97	3	Hallock	22	24	3.24	+.02	Thief River Falls	13.02	Willmar CAA	.50
Mississippi	73.7	+1.9	Leakesville	97	23	2 stations	44	12	4.68	+.37	Rockport	9.54	Pearlington	2.00
Missouri	67.6	+3.1	Joplin	95	31	Elsberry	34	11	4.59	−.19	Lexington	8.84	Webster Groves	2.00
Montana	55.8	+3.7	Westby	100	28	Loweth	14	6	1.94	−.15	Lakeview	4.78	Albion	.38
Nebraska	62.1	+2.8	Culbertson	100	3	4 stations	32	[1] 1	4.84	+1.42	Pawnee City	8.01	Blair	2.07
Nevada	56.5	+.9	Overton	109	26	Sheldon	17	1	1.77	+.99	Owyhee	4.55	Overton	.02
New England	56.1	+1.0	Springfield News Bldg., Mass.	96	6	2 stations	22	11	3.75	+.27	Wepawaug Res., Conn.	7.71	St. Albans, Vt.	1.57
New Jersey	61.4	+.8	Phillipsburg	98	6	Layton	29	13	4.77	+1.15	Trenton No. 2	6.74	Cape May	3.07
New Mexico	60.8	+1.1	Jal	102	31	Red River	10	1	1.23	+.01	Clayton, 9 SE	7.36	6 stations	.00
New York	56.9	+0.8	Millbrook	96	14	Angelica	20	11	3.15	−.42	Parkston	7.41	Barker	.91
North Carolina	67.6	+0.7	2 stations	94	[1] 20	2 stations	29	[1] 28	4.61	+.60	McCullers	10.14	Hiwassee Dam	2.15
North Dakota	56.6	+3.1	do	93	[1] 12	Belcourt Indian Reservation.	19	24	2.34	+.08	Mayville	6.38	Dickinson CAA	.45
Ohio	62.6	+2.0	do	98	[1] 5	Mineral Ridge Water Works.	27	11	3.05	−.72	Findlay CAA	5.86	St. Martin Ursuline Sch.	.56
Oklahoma	70.2	+1.9	Tipton	103	31	Kenton	37	1	7.94	+3.13	Carnegie	13.58	Texhoma	2.63
Oregon	56.7	+3.4	McNary Dam	99	[1] 12	Crater Lake NPS Hq.	14	3	2.37	+.58	Valsetz	9.15	Arlington	.08
Pennsylvania	60.0	+.4	2 stations	96	[1] 6	Kane, 1 NNE	20	11	3.78	−.25	Philadelphia Drexel Inst.	8.34	Murrysville	1.81
South Carolina	70.9	.0	3 stations	96	[1] 21	Rainbow Lake	42	12	3.42	−.09	Beaufort	6.43	Saluda	1.38
South Dakota	59.9	+3.5	2 stations	97	3	Hardy R. S.	20	1	2.58	−.27	Aberdeen	6.36	Milesville	.45
Tennessee	68.3	+1.4	do	94	7	Rugby	34	27	3.68	−.43	Savannah	10.32	Strawberry Plains	1.30
Texas	74.2	+1.2	Boquillas R. S.	114	30	Vega	37	1	3.25	−.45	Arlington	14.69	2 stations	.00
Utah	57.0	+1.2	St. George CAA	99	[1] 25	Silver Lake (Brighton).	17	6	1.92	+.84	Timpanogos Cave	6.12	Piute Dam	T
Virginia	64.2	−.1	Lincoln	95	6	Burkes Garden	27	29	4.75	+.97	Mons	8.17	Emory	1.49
Washington	57.9	+2.8	Richland, 2 SW	100	[1] 12	Mt. Baker Lodge	18	4	1.14	−.87	Wind River	5.44	White Swan	T
West Virginia	62.8	+1.1	Cabwaylingo State Forest.	101	6	Cranberry Glades	25	30	3.74	−.26	Weston	5.84	Huntington, WB City.	1.94
Wisconsin	57.6	+2.4	Stoughton	95	5	Land O Lakes	21	28	2.28	−1.33	Brule R. S.	7.08	Shawano	.44
Wyoming	52.3	+2.5	2 stations	90	[1] 3	2 stations	17	1	2.57	+.60	Albin	5.68	Basin	.69
Alaska (Apr.)	21.0	−6.2	Homer	60	21	Umiat	−41	12	1.76	+.29	Ketchikan	31.19	Hughes	T
Hawaii	70.8	−.7	2 stations	89	[1] 6	Hilo Nat'l Park	43	24	3.45	−3.08	North Wailua River Leas.	15.10	4 stations	.00
Puerto Rico	77.2	+.3	Utuado (2)	95	29	Cayey	53	1	5.43	−2.55	San Lorenzo (Espino).	17.23	Adjuntas	1.09

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MAY 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [2]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover [3] tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	M. p.h.					0-3	4-7	8-10	0-10	%
NEW ENGLAND									53.7	+1.5					73			3.65	+.3															7.0	
Caribou [3]	628	5	33	991.5	1,014.8	.....	61	38	49.6	−1.1	82	1	30	10	478	39	66	3.91	+.9	1.00	18	3	T	0	13.3	.....	...	...	...	2	6	23	8.1	...
Eastport	75	67	82	1,012.5	1,015.2	+1.3	56	42	49.0	+1.3	74	5	36	26	492	...	...	3.04	.0	1.24	13	3	.0	0	9.7	.....	27	e.	12	4	8	19	7.1	55
Portland, Me. [3]	103	6	43	1,009.5	1,015.5	+.9	66	42	53.8	+2.6	86	19	30	26	358	46	75	3.50	+.1	1.33	14	4	T	0	7.2	.....	28	ne.	9	4	14	13	6.7	64
Concord [3]	289	5	45	1,005.1	1,015.8	+1.2	70	41	55.6	+2.7	90	5	31	26	308	45	68	3.68	+.7	.98	11	3	.0	0	6.7	.....	29	nw.	5	4	8	19	7.6	47
Mt. Washington	6,274	5	37	807.0	1,020.7	.....	43	30	36.2	+.5	57	5	18	11	890	...	...	5.66	−.1	1.21	18	1	9.4	6	28.8	.....	...	...	...	3	8	20	7.7	29
Burlington [3]	403	6	51	1,000.3	1,015.3	+1.1	69	44	56.5	.0	82	18	32	11	273	47	68	1.58	−1.3	.32	13	5	.0	0	9.3	.....	35	s.	22	7	10	14	6.6	52
Boston [3]	124	33	62	1,011.5	1,016.2	+1.6	70	51	60.4	+3.3	90	19	42	13	192	47	64	2.53	−.6	.83	14	4	T	0	12.3	.....	34	ne.	12	4	14	13	6.6	63
Nantucket [3]	12	4	34	1,016.3	1,016.9	+2.3	60	46	52.8	+.5	68	4	40	16	376	49	86	1.78	−1.1	.40	10	2	.0	0	13.2	.....	35	ne.	20	7	9	15	6.5	54
Block Island	26	11	46	1,015.9	1,016.7	+2.1	61	48	54.5	+1.7	72	4	40	12	324	50	88	2.93	−.6	.72	9	4	.0	0	15.1	.....	45	ne.	20	4	15	12	6.3	65
Providence [3]	159	65	60	1,010.5	1,016.6	+2.0	71	50	60.6	+2.1	94	5	42	16	186	48	71	3.47	+.5	1.30	11	3	.0	0	8.7	.....	35	sw.	2	5	14	12	6.2	60
Hartford [3]	159	5	44	1,010.8	1,016.6	+1.7	72	48	57.9	+2.2	93	5	37	30	193	50	73	5.63	+2.0	1.65	17	7	.0	0	9.5	.....	32	se.	7	2	13	16	7.5	68
New Haven [3]	197	5	39	1,012.5	1,016.6	+1.7	68	48	58.0	+2.6	81	7	38	26	224	50	68	6.14	+2.8	1.65	15	5	.0	0	6.6	.....	18	se.	15	3	15	13	6.8	66
MIDDLE ATLANTIC									63.1	+1.0							70	4.43	+1.0														6.3	
Albany [3]	97	6	40	1,011.9	1,015.8	+1.6	70	45	57.8	+.1	90	5	32	21	252	46	66	3.20	+.6	1.09	15	6	.0	0	9.4	.....	42	nw.	25	5	9	17	7.0	64
Binghamton [4]	871	57	79	985.8	1,016.6	+1.7	71	46	58.8	+1.4	90	6	33	11	231	47	72	4.93	+1.6	1.64	13	10	T	0	5.6	.....	30	s.	18	3	11	17	7.4	61
New York [4]	314	415	454	1,005.8	1,017.2	+2.6	71	54	62.3	+1.7	92	6	46	13	141	50	65	4.11	+.9	.77	13	7	.0	0	12.6	.....	68	sw.	22	4	16	11	6.6	57
Allentown [3]	385	4	58	1,003.1	1,017.2	.....	74	49	61.1	+.6	92	5	36	30	173	51	72	4.20	+.7	1.02	14	6	.0	0	6.4	.....	...	...	...	6	13	12	6.5	...
Harrisburg [3]	374	30	49	1,003.1	1,016.8	+1.6	74	51	62.4	+.6	93	5	38	12	138	51	67	2.12	−1.3	.56	15	8	T	0	5.9	.....	37	w.	22	4	10	17	7.0	66
Philadelphia [4]	114	174	150	1,013.2	1,016.8	+1.2	74	55	64.4	+1.5	88	6	47	12	96	53	69	6.23	+3.0	1.62	15	8	.0	0	7.2	.....	24	e.	20	7	12	12	6.1	63
Reading	323	47	306	1,005.1	1,016.9	+2.0	74	52	63.5	+1.6	92	5	41	30	125	...	...	3.56	−.1	1.07	13	5	T	0	9.0	.....	47	w.	22	5	14	12	6.4	67
Scranton	805	72	104	987.8	1,016.6	+1.4	72	49	60.2	+.8	90	5	38	30	201	...	...	3.68	+.4	1.60	14	4	...	...	6.0	.....	54	nw.	5	6	17	8	5.7	52
Atlantic City	52	37	172	1,014.9	1,017.1	+1.9	65	53	59.2	+1.1	79	7	47	29	191	52	78	4.01	+1.0	1.08	14	4	T	0	15.6	.....	45	ne.	11	5	9	17	6.9	65
Newark [3]	30	5	46	1,015.6	1,016.6	.....	73	51	62.4	+1.0	94	5	39	30	149	50	68	4.01	+.1	1.12	15	6	T	0	9.8	.....	...	...	...	4	14	13	6.7	...
Trenton	190	89	107	1,009.8	1,016.6	+1.4	72	52	62.4	+1.3	91	6	41	30	142	...	...	5.09	+2.0	1.16	22	6	.0	0	8.3	.....	30	nw.	29	5	13	13	6.6	49
Baltimore [4]	123	100	215	1,012.5	1,017.3	+2.1	75	57	66.5	+1.4	92	6	45	12	79	53	69	5.90	+2.4	1.80	13	9	T	0	9.4	.....	35	nw.	20	8	13	10	5.9	57
Washington [4]	112	56	100	1,013.7	1,017.2	+2.0	77	56	66.4	+2.7	94	6	42	12	71	52	66	5.65	+2.0	1.60	15	7	.0	0	6.5	.....	47	nw.	7	4	16	11	6.3	61
Cape Henry	18	8	54	1,016.3	1,016.9	+1.3	72	58	64.8	+.6	90	19	47	13	80	...	...	3.23	−.3	.98	9	4	.0	0	11.8	.....	42	n.	7	12	10	9	5.1	64
Lynchburg [3]	686	5	58	983.4	1,017.1	+1.5	77	54	65.4	−.5	89	7	39	12	75	53	68	3.84	+.2	1.45	11	11	.0	0	6.7	.....	29	n.	7	11	10	10	5.2	70
Norfolk [4]	91	80	125	1,013.9	1,017.5	+1.6	76	58	67.2	+1.0	90	19	49	14	49	57	74	5.42	+1.6	1.86	11	8	.0	0	9.1	.....	31	n.	7	6	16	9	5.7	76
Richmond [4]	144	11	52	1,010.5	1,016.9	+1.3	78	56	66.6	+.1	90	19	46	12	55	56	73	6.11	+2.3	1.66	15	10	T	0	6.4	.....	27	n.	20	6	16	9	5.7	76
SOUTH ATLANTIC									70.8	+1.0							71	4.01	+.2														5.0	
Asheville	2,253	77	92	944.5	1,017.3	+1.0	78	53	65.0	+2.4	87	5	42	27	60	54	...	3.70	+.3	1.44	13	8	T	0	6.2	nw	37	ne	6	9	10	12	5.9	78
Charlotte [4]	779	63	86	989.5	1,017.1	+1.2	81	60	70.4	+1.5	89	7	45	12	19	56	68	2.90	−.7	1.04	13	...	...	...	6.1	ssw	31	w	22	10	12	9	5.5	77
Greensboro [3]	886	6	56	985.8	1,017.5	+.9	79	55	67.0	+.6	88	7	43	28	46	55	70	3.06	−1.0	.68	14	13	.0	0	8.0	sw	40	nw	26	10	12	9	5.0	71
Hatteras	11	5	47	1,016.6	1,017.3	+1.4	74	63	68.1	−.6	80	24	56	12	17	62	83	5.79	−2.1	3.36	11	6	.0	0	11.3	ne	33	w	23	8	14	9	5.6	70
Raleigh [4]	376	5	71	1,001.7	1,017.4	+1.8	80	58	69.0	+.5	90	19	47	12	27	58	74	7.48	+3.7	3.37	12	8	.0	0	6.5	sw	24	sw	24	11	10	10	5.1	53
Wilmington	72	73	107	1,015.9	1,017.3	+1.0	79	62	70.8	.0	89	20	52	13	10	61	...	4.25	+.8	1.04	10	6	T	0	8.7	se	38	w	25	12	12	7	4.7	71
Charleston [4]	48	11	92	1,014.9	1,016.7	+.4	81	66	73.2	+.5	93	20	55	12	1	62	77	6.19	+3.2	2.25	12	9	.0	0	9.1	ssw	32	w	10	12	12	7	4.6	77
Columbia, S. C. [4]	347	70	91	1,008.5	1,016.6	+.7	84	62	73.0	+1.1	91	20	52	12	6	59	67	1.96	−1.1	.87	10	4	T	0	7.5	ne	27	sw	22	14	10	7	4.3	73
Greenville, S. C. [3]	1,040	18	36	980.0	1,016.8	+1.2	80	59	69.2	+2.0	87	7	47	12	17	57	68	3.20	−.8	.85	15	11	T	0	7.1	ne	36	w	24	14	7	10	5.0	74
Augusta [4]	182	62	77	1,001.4	1,016.8	+1.2	85	62	73.8	+1.4	92	20	53	12	1	58	63	3.68	+.6	1.65	10	9	.0	0	5.2	se	29	s	10	13	9	9	4.6	81
Savannah [3]	65	19	51	1,014.6	1,016.8	+.5	84	63	73.6	+1.9	92	20	53	13	2	62	72	2.73	−.3	1.35	7	9	.0	0	9.3	sw	39	nw	25	10	13	8	5.1	77
Jacksonville [4]	43	86	110	1,015.6	1,017.0	+.7	85	67	76.0	+1.0	92	24	57	13	0	64	70	3.17	−.8	1.32	4	5	.0	0	8.4	ne	28	nw	2	13	13	5	4.2	78
FLORIDA PENINSULA									79.0	+1.5							70	2.52	−2.0														3.9	
Key West [4]	21	10	64	1,015.2	1,015.8	+.9	86	76	80.8	+1.7	88	31	69	3	0	70	73	1.01	−2.5	.62	6	5	.0	0	8.4	e.	23	e.	1	19	10	2	3.5	80
Miami [4]	25	242	249	1,014.9	1,015.8	−.1	83	72	77.4	+.2	90	26	64	6	0	66	71	5.03	−2.1	2.63	11	10	.0	0	12.3	ne.	32	ne.	16	13	16	2	4.1	82
Tampa [3]	35	5	36	1,014.9	1,016.5	+.6	90	67	78.8	+2.5	95	27	60	13	0	64	65	1.52	−1.5	1.04	4	7	.0	0	7.3	e.	25	n.	31	15	13	3	4.0	83
EAST GULF									74.4	+1.7							69	2.33	−1.4														4.6	
Atlanta [3]	1,173	33	72	975.6	1,016.5	+.6	82	61	71.7	+1.4	89	6	53	12	1	57	65	1.87	−1.6	.48	10	8	T	0	7.2	nw.	40	nw.	1	12	11	8	5.0	66
Macon [4]	370	79	87	1,003.7	1,016.7	+.8	85	61	72.8	+.5	92	20	52	13	1	59	63	1.05	−1.9	.48	9	9	.0	0	5.8	nnw.	32	sw.	1	10	13	8	5.5	76
Apalachicola	35	11	51	1,015.2	1,016.6	+.7	83	69	76.0	+1.4	92	6	62	13	0	...	...	.91	−2.5	.45	4	3	.0	0	8.4	sw.	31	n.	6	21	7	3	2.8	87
Pensacola [4]	56	54	79	1,014.9	1,016.9	+1.0	83	68	75.6	+1.7	94	7	60	11	0	65	...	2.06	−1.3	1.55	8	5	.0	0	7.5	sw.	26	ne.	1	16	7	8	4.2	84
Anniston	618	6	32	993.6	1,017.0	+1.4	84	58	70.9	.....	91	8	46	26	3	60	72	3.53	−.4	1.35	9	10	T	0	5.1	w.	...	...	...	...	6	10	15	5.0	...
Birmingham [3]	700	5	63	994.2	1,016.8	+.9	84	59	71.5	+2.2	90	6	50	26	0	59	69	3.37	−.6	1.50	11	10	T	0	8.4	ene.	47	sw.	23	9	12	10	5.4	60
Mobile [4]	57	86	161	1,008.8	1,016.8	+1.2	86	67	76.1	+1.7	92	8	59	12	0	64	71	3.21	−1.1	1.47	6	6	.0	0	10.6	sw.	39	se.	2	13	13	5	4.5	76
Montgomery [4]	218	92	105	1,009.1	1,016.5	+.6	86	64	75.2	+1.8	92	6	59	26	0	60	66	2.88	−1.0	1.67	7	4	.0	0	6.7	e.	37	w.	23	17	5	9	4.0	78
Meridian [4]	375	67	92	1,005.4	1,016.7	+1.5	87	60	73.2	+1.9	93	22	52	13	0	62	73	4.33	.0	1.82	10	10	.0	0	6.2	s.	...	...	...	15	7	9	4.6	...
Vicksburg [4]	247	82	102	1,006.8	1,016.3	+1.1	85	65	74.8	+1.9	88	4	52	12	0	63	...	2.71	−1.6	1.37	6	7	T	0	8.1	s.	37	nw.	30	5	18	8	5.8	64
New Orleans C. O	53	76	84	1,014.6	.....	.....	87	70	78.3	+2.9	91	23	62	2	0	...	...	1.01	−3.6	.86	5	2	.0	0	6.3	se.	28	ne.	30	14	12	5	4.2	83
New Orleans A. P. [3]	30	6	52	1,014.6	1,016.5	+1.3	87	66	76.4	.....	91	31	56	14	0	65	71	.99	.....	.56	4	5	.0	0	7.3	s.	30	nne.	30	14	13	4	4.6	...
WEST GULF									77.5	+3.2							74	2.82	−1.2														6.2	
Shreveport [3]	181	5	64	1,008.5	1,015.3	+.7	88	66	77.0	+3.7	94	30	52	13	0	65	72	1.63	−2.6	1.16	5	5	.0	0	9.7	sse.	46	s.	28	7	15	9	5.7	72
Fort Smith [3]	463	6	30	998.0	1,014.0	+.8	84	62	72.9	+3.3	94	31	51	12	0	61	72	4.38	−.4	.89	16	11	T	0	7.1	ne.	40	nw.	24	2	11	18	7.2	68
Little Rock [3]	265	26	58	1,002.4	1,015.6	+1.4	84	63	73.1	+2.8	90	6	50	12	2	62	72	2.37	−2.4	.88	11	9	.0	0	7.3	se.	29	nw.	9	6	16	9	5.7	66
Austin [3]	621	5	41	992.6	1,014.1	+1.2	87	68	77.6	+3.0	97	30	56	13	0	67	75	.83	−3.8	.39	9	8	.0	0	9.5	sse.	28	s.	16	6	15	10	6.1	63
Brownsville [3]	20	5	54	1,009.5	1,011.0	−.9	88	73	80.5	+1.9	92	30	66	22	0	71	77	1.85	−.7	1.41	4	3	.0	0	13.6	se.	33	se.	16	3	20	8	5.8	77
Corpus Christi [3]	44	6	33	1,012.9	1,014.0	+1.1	87	72	79.6	+5.1	93	31	64	13	0	72	79	.19	−3.0	.19	1	3	T	0	12.2	sse.	31	se.	16	5	19	7	6.1	52
Dallas [3]	488	34	45	996.3	1,013.9	+1.0	86	66	76.2	+3.3	97	31	56	11	0	64	68	8.94	+4.5	5.44	10	10	T	0	10.5	s.	48	sw.	26	6	11	14	6.1	61
Fort Worth [3]	706	40	56	988.8	1,015.6	+2.7	86	66	75.7	+3.5	97	31	57	10	0	62	72	10.64	+6.0	6.03	9	11	.0	0	14.2	s.	...	...	...	10	9	12	5.8	...
Galveston [4]	54	122	129	1,014.9	1,015.5	+.9	81	74	77.8	+3.0	85	30	68	11	0	71	81	2.56	−.9	1.15	4	4	.0	0	13.1	s.	38	se.	21	...	...	...	...	60
Houston [4]	138	157	190	1,012.5	1,014.9	+1.0	86	71	78.6	+3.1	95	31	61	12	0	70	79	1.36	−3.1	1.28	4	4	.0	0	10.7	se.	34	se.	16	3	12	16	6.9	54
Laredo [3]	418	10	38	996.6	1,011.6	.....	93	73	82.8	+1.8	102	30	65	13	0	68	65	.49	−3.2	.47	4	7	.0	0	14.1	se.	...	...	...	2	10	19	7.4	...
Palestine	510	64	72	997.0	.....	.....	85	67	76.0	+3.3	92	31	57	12	0	...	...	2.32	−2.2	1.31	5	4	.0	0	7.6	s.	25	nw.	29	4	15	12	6.2	78
Port Arthur [4]	34	59	134	1,014.6	1,015.3	+1.1	85	72	78.7	+3.5	90	31	62	12	0	68	78	1.11	−3.0	1.02	5	5	.0	0	13.0	s.	43	s.	21	7	16	8	5.4	69
San Antonio [3]	794	6	51	985.4	1,013.6	+1.1	88	69	78.4	+3.3	98	30	58	13	0	66	72	.85	−2.4	.70	3	2	.0	0	9.1	se.	33	nw.	28	5	9	17	6.8	58

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MAY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and hail on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover [7] tenths (sunrise to sunset): 0-3	Sky cover [7] tenths (sunrise to sunset): 4-7	Sky cover [7] tenths (sunrise to sunset): 8-10	Sky cover [7] tenths (sunrise to sunset): 0-10	Possible sunshine [8]
	Ft.	*Ft.*	*Ft.*	*Mbs.*	*Mbs.*	*Mbs.*	°F	°F.	°F.	°F.	°F.		°F.			°F.	%	*In.*	*In.*	*In.*			*In.*	*In.*	*M. p.h.*												%
OHIO VALLEY AND TENNESSEE									65.9	+1.7							67	3.02	−.7															5.5			
Chattanooga [2]	762	6	66	991.9	1,016.6	+.7	83	57	70.1	+.9	92	5	49	26	4	59	73	2.33	−1.5	.83	9	10	T	0	3.4	n.	45	w.	24	9	9	13	5.6	71
Knoxville [2]	995	27	71	982.4	1,017.0	+1.1	81	57	68.8	+2.1	89	6	46	27	19	56	68	2.57	−1.2	.88	11	9	T	0	6.6	ne.	42	sw.	1	8	14	9	5.3	74
Memphis [2]	399	5	49	1,001.4	1,015.5	+.6	83	62	72.6	+2.8	90	6	45	12	10	60	68	3.93	−.3	1.12	9	11	.0	0	7.0	s.	32	sw.	24	11	9	11	5.1	73
Nashville [2]	546	5	72	997.0	1,016.4	+.5	82	58	69.7	+1.5	92	5	47	11	19	59	72	5.65	+1.8	1.37	12	9	T	0	5.5	sse.	56	w.	22	12	7	12	5.1	72
Lexington [2]	989	4	58	981.7	1,017.2	+1.6	78	53	65.7	+1.4	90	5	39	11	75	53	65	1.87	−1.9	.95	8	6	.0	0	8.1	s.				14	10	7	4.2	--
Louisville [2]	525	5	54	998.6	1,016.5	+.9	81	55	67.8	+2.7	94	5	41	11	46	53	61	3.14	−.6	2.19	10	5	.0	0	6.8	ssw.	33	sw.	22	12	12	7	5.0	81
Evansville [2]	431	6	40	1,001.0	1,016.6	+1.4	79	54	66.6	+2.3	91	6	43	11	54	55	69	3.54	−.3	1.87	6	4	T	0	7.8	ssw.	38	ne.	9	16	6	9	4.7	76
Indianapolis [2]	823	5	54	987.1	1,016.5	+1.3	75	51	63.1	+1.7	89	5	36	11	126	51	66	2.75	−1.1	1.66	11	7	.0	0	10.4	sw.	52	w.	22	8	10	13	6.0	68
Terre Haute [2]	575	4	36	995.6	1,016.6	+1.7	76	51	63.9	+.5	89	6	37	11	101	52	68	4.50	+.6	1.31	11	10	T	0	9.6	sse.	34	s.	15	10	5	16	6.0	66
Cincinnati [4]	627	135	148	985.4	1,017.0	+1.4	79	56	67.2	+2.1	93	5	41	11	60	50	62	2.23	−1.5	1.31	8	7	.0	0	4.3	ssw.	17	nw.	24	10	11	10	5.5	77
Columbus [4]	822	90	110	987.1	1,017.2	+1.6	76	53	64.6	+2.3	92	5	39	11	111	50	67	2.05	−1.5	53	12	7	.0	0	8.9	se.	39	s.	19	10	10	11	5.4	76
Dayton [2]	1,003	6	55	980.7	1,017.0	+2.1	74	51	62.6	+.8	89	5	35	11	146	49	65	2.22	−1.4	56	12	8	T	0	10.2	ssw.	47	w.	22	8	10	13	5.9	66
Elkins [2]	1,947	5	45	946.8	1,017.6	+1.3	72	45	58.6	+.9	86	6	30	27	209	49	74	3.29	−.8	1.55	11	4	.0	0	5.6	------	36	n.	22	6	12	13	6.4	64
Parkersburg	637	77	84	------	------	------	77	52	64.6	+.8	93	5	35	27	99	----	----	2.93	−.4	1.49	10	8	----	----	6.1	------	29	s.	22	11	9	11	5.1	64
Pittsburgh [2]	842	39	54	971.2	1,016.7	+1.5	74	51	62.6	+2.4	90	5	37	28	143	48	61	2.26	−1.0	.73	12	5	.0	0	9.3	------	35	s.	22	4	12	15	6.6	55
LOWER LAKES									59.4	+2.6							63	3.27	+.1													5.6			
Buffalo [2]	768	34	96	988.5	1,016.5	+1.6	69	47	57.6	+1.7	87	17	31	11	248	45	63	2.09	−1.0	.90	10	4	.0	0	13.4	------	43	sw	2	7	13	11	5.8	69
Canton	448	10	61	999.0	1,015.0	+1.7	67	45	56.0	+1.8	82	4	31	11	293	45	61	2.49	−.5	.84	11	4	T	0	8.1	------	28	w	19	6	11	14	6.5	57
Oswego	335	71	85	1,003.4	1,015.6	+1.0	66	48	56.8	+3.1	86	4	38	12	282	----	--	1.83	−1.2	.90	11	2	.0	0	8.4	------	26	n.	10	12	12	7	5.0	69
Rochester [2]	523	4	69	997.0	1,016.4	+1.2	71	46	58.6	+1.5	91	4	34	12	236	45	63	2.08	−.9	.73	10	3	.0	0	10.4	------	42	w.	2	9	14	8	5.8	81
Syracuse [2]	596	5	57	994.6	1,016.3	+1.1	71	45	58.4	+2.1	88	4	29	11	243	46	64	2.37	−.6	.68	11	6	T	0	7.8	- - -	49	sw.	5	6	14	11	6.1	70
Erie [4]	714	57	81	------	------	------	68	52	59.5	+2.7	84	18	38	11	217	----	--	3.70	+.3	1.57	9	5	.0	0	7.5	------	27	w.	2	14	14	3	4.2	65
Cleveland [2]	762	27	54	988.8	1,016.7	+1.5	73	51	61.8	+3.7	89	5	38	29	175	47	63	4.18	+1.1	1.80	13	4	T	0	10.8	sw.	56	sw.	19	8	12	11	5.8	75
Sandusky	629	5	67	994.6	------	------	72	53	62.5	+3.3	92	5	42	12	155	----	--	4.15	+1.0	1.91	12	9	.0	0	8.1	------	25	nw.	24	9	17	5	4.5	80
Toledo [2]	628	5	47	993.2	1,016.4	+1.2	72	49	60.8	+2.8	90	6	33	11	193	49	66	4.28	+.8	1.67	9	5	.0	0	10.6	sw.	37	nw.	10	8	10	13	6.1	77
Fort Wayne [2]	857	5	34	986.1	1,016.4	+1.2	73	50	61.4	+2.2	88	5	34	11	176	49	66	4.80	+1.0	2.53	13	7	.0	0	7.8	sw.	34	s.	18	8	11	12	5.7	70
Detroit [2]	730	5	77	993.9	1,016.7	+1.5	72	49	60.4	+3.5	90	6	33	11	209	45	59	3.96	+.8	1.72	9	8	T	0	9.9	s.	41	nw.	18	6	12	13	6.2	60
UPPER LAKES									55.0	+2.5							66	2.63	−.6													5.9			
Alpena	609	5	89	993.9	------	------	62	43	52.6	+2.1	88	5	33	11	401	----	--	2.55	−.5	.62	10	5	.0	0	10.0	------	35	sw.	18	6	11	14	6.4	67
Escanaba	612	51	72	993.6	------	------	59	42	50.3	+.7	75	5	34	28	456	----	--	4.46	+1.5	2.14	11	6	T	0	10.7	------	42	n.	6	8	11	12	6.1	59
Grand Rapids [4]	707	702	44	991.2	1,016.1	+1.2	72	50	61.0	+3.0	88	5	34	11	191	46	65	1.33	−2.1	.39	12	6	.0	0	10.7	wsw.	73	sw.	2	9	11	11	5.7	62
Lansing [4]	878	5	90	984.4	1,016.5	+1.6	72	47	59.5	+2.7	89	6	29	11	228	46	63	2.35	−1.1	1.29	7	3	.0	0	11.6	sw.	35	w.	24	10	10	11	5.7	68
Marquette	734	44	73	988.5	------	------	61	40	50.6	+1.6	92	3	29	10	480	----	--	3.29	+.3	1.84	11	6	T	0	8.2	------	29	s.	3	7	9	15	6.5	62
Sault Sainte Marie [2]	614	10	52	989.2	1,016.1	+.9	62	39	50.2	+2.0	79	18	29	12	464	39	70	3.20	+.6	1.59	10	6	.0	0	10.7	nw.	38	nw.	26	8	8	15	6.3	65
Chicago [2]	673	5	38	993.9	1,016.0	+1.1	74	49	61.5	+3.7	94	5	36	11	184	47	62	2.46	−1.0	1.55	12	6	T	0	9.1	ssw.	30	s.	18	12	6	13	5.4	67
Green Bay	617	5	32	993.2	------	------	69	46	57.2	+2.3	90	5	31	28	287	----	--	.71	−2.8	.21	7	3	T	0	8.7	------	35	sw.	2	7	10	14	6.3	65
Milwaukee [2]	681	33	66	990.5	1,016.1	+1.5	68	46	57.0	+4.4	89	5	34	26	291	45	65	1.72	−1.6	.54	10	5	.0	0	13.4	nne.	42	w.	2	8	11	12	5.8	65
Duluth [4]	1,133	5	47	963.4	1,015.2	+.6	60	40	50.0	+2.7	77	18	33	10	463	39	68	4.20	+1.0	2.06	14	6	T	0	11.2	ese.	52	w.	3	10	14	7	5.1	60
NORTH DAKOTA									57.4	+3.7							62	2.53	+.2													6.6			
Fargo [2]	940	5	47	978.7	1,013.2	−.3	71	44	57.6	+2.5	88	31	28	24	267	43	61	3.54	+.7	.99	10	7	T	0	14.0	n.	39	s.	31	7	11	13	6.4	61
Bismarck [2]	1,677	5	41	953.6	1,013.0	−.9	72	44	58.4	+5.4	89	29	30	24	237	44	62	2.15	−.2	1.18	9	3	.0	0	11.9	nnw.	38	nw.	1	5	18	18	6.8	62
Devils Lake	1,478	11	44	960.0	------	------	68	42	55.0	+2.4	87	12	29	24	325	----	--	2.76	+.7	.78	3	5	T	0	8.9	------	29	ne.	31	8	14	9	5.7	60
Williston	1,878	42	50	945.5	------	------	71	46	58.4	+4.4	91	12	28	23	244	----	--	1.68	−.4	1.25	9	5	T	0	7.9	------	32	nw.	1	4	8	19	7.3	79
UPPER MISSISSIPPI																															6.0			
Minneapolis-St. Paul [2]	919	43	74	980.4	1,013.8	+.6	73	51	64.2	+3.2	93	3	38	24	158	46	64	1.92	−2.2	.90	10	6	.0	0	11.1	se.	34	s.	3	6	16	9	5.9	61
La Crosse [2]	672	5	29	990.2	1,014.5	+.6	73	49	62.0	+4.3	90	5	35	26	184	48	64	1.81	−1.9	.72	10	4	.0	0	10.0	s.	42	w.	2	9	7	15	6.2	70
Madison [2]	974	27	39	984.4	1,015.9	+1.3	72	46	61.2	+3.3	90	5	32	10	233	46	64	2.22	−1.6	1.17	12	4	.0	0	11.5	s.	63	w.	2	8	7	16	6.4	63
Charles City	1,015	10	51	979.3	1,015.9	+1.7	72	49	59.3	+1.7	90	5	39	24	164	----	--	2.11	−2.2	.66	12	5	.0	0	7.0	------	28	sw.	3	12	8	11	5.5	54
Moline [2]	606	6	50	993.2	1,015.8	+1.2	76	52	60.6	+2.8	90	3	39	24	106	50	63	1.82	−2.1	.72	12	5	.0	0	10.0	e.	33	sw.	18	11	7	13	5.8	64
Des Moines [4]	860	5	99	980.0	1,014.7	+1.2	76	55	63.9	+3.6	93	5	37	11	125	53	68	1.23	−3.3	.50	10	5	.0	0	10.0	------	31	nw.	1	5	10	16	6.8	56
Dubuque	699	60	79	989.8	1,015.2	+1.0	73	53	65.4	+4.1	89	5	44	11	85	53	68	1.23	−3.3	.50	10	5	.0	0	10.0	------	31	nw.	1	5	10	16	6.8	56
Burlington [2]	702	4	36	989.8	1,015.5	+1.6	77	53	63.1	+2.8	92	5	39	10	140	49	64	1.95	−2.3	1.38	7	2	.0	0	.56	------	17	s.	3	8	5	18	6.5	66
Cairo	357	5	99	1,003.1	------	------	81	61	65.2	+2.6	92	5	41	11	94	53	68	.96	−3.2	.27	10	2	.0	0	12.1	------	38	w.	1	7	11	13	6.1	71
Peoria [2]	609	7	26	993.6	1,015.9	+1.0	76	52	64.4	+3.6	90	5	40	11	107	50	62	1.17	−2.9	.39	8	5	.0	0	8.0	------	31	n.	20	9	9	13	5.5	78
Springfield, Ill. [4]	636	5	49	993.2	1,015.7	+1.5	78	54	65.6	+5.1	90	5	37	11	79	52	64	2.52	−1.9	1.41	11	5	.0	0	10.9	ssw.	40	sw.	1	9	9	13	5.7	67
St. Louis [4]	568	33	59	994.9	1,015.3	+1.1	79	60	69.2	+2.2	91	3	46	11	24	54	63	2.77	−1.6	1.23	11	5	.0	0	12.4	s.	37	w.	1	7	11	13	6.0	75
MISSOURI VALLEY									65.5	+3.8							71	4.95	+.9													6.8			
Columbia, Mo. [4]	784	6	66	986.5	1,014.7	+.1	78	58	68.3	+3.3	90	5	46	11	35	56	72	6.23	+1.8	1.74	14	12	.0	0	7.1	------	26	nw.	23	9	10	12	6.1	62
Kansas City [2]	963	38	76	981.7	1,014.1	+.6	78	60	68.9	+4.1	89	5	48	11	27	56	67	5.31	+1.4	1.69	14	7	T	0	9.2	------	35	sw.	21	3	11	17	7.1	67
St. Joseph [2]	967	5	51	979.0	1,013.8	+.3	77	58	67.4	+3.2	88	5	45	11	44	57	71	4.07	−.6	1.72	13	11	T	0	11.3	------	63	w.	31	4	10	17	7.0	64
Springfield, Mo. [2]	1,324	5	50	968.2	1,015.4	+1.2	75	57	66.4	+2.7	88	4	44	11	35	58	75	5.37	+.2	1.24	14	14	T	0	9.7	------	50	se.	21	8	10	13	6.4	67
Topeka [4]	967	65	87	982.1	1,013.8	+.6	79	59	69.1	+4.8	89	5	49	11	21	58	75	6.11	+1.6	2.60	14	12	T	0	9.2	------	24	s.	3	4	8	19	7.5	56
Lincoln [4]	1,189	6	81	970.5	1,013.4	+.5	75	56	65.0	+3.3	90	3	42	2	94	56	76	5.48	+1.4	1.82	15	12	.0	0	9.5	------	38	nw.	1	5	6	20	7.3	59
Norfolk, Nebr. [2]	1,551	5	38	958.0	1,013.5	------	73	53	63.0	+2.8	92	3	36	24	126	53	72	4.20	+.2	2.21	12	13	T	0	----	------	----	------	----	7	8	16	6.6	--
Omaha [2]	1,105	5	68	973.9	1,013.7	+.2	76	56	66.0	+3.6	92	3	44	24	73	55	69	3.94	+.2	1.26	14	13	.0	0	11.6	------	37	s.	3	7	3	21	6.9	57
Valentine	2,598	46	54	921.8	1,012.5	−1.0	72	49	60.5	+4.3	88	3	34	24	170	47	64	6.96	+4.1	3.76	12	6	T	0	8.9	------	33	nw.	1	8	6	17	6.8	67
Sioux City [2]	1,138	5	40	972.6	1,013.4	+.2	75	53	64.1	+4.4	94	3	37	24	113	54	71	4.20	+.2	1.31	14	9	T	0	11.3	------	52	w.	17	5	9	17	6.8	65
Huron [2]	1,301	5	41	966.1	1,012.9	−1.0	75	48	61.6	+5.2	94	3	33	24	173	48	64	2.60	−.4	1.05	10	9	T	0	12.9	------	49	nw.	1	7	8	16	6.8	57

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MAY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [4]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
NORTHERN SLOPE	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F		°F.			°F.	%	In.	In.	In.			In.	In.	M. p. h.					0–3	4–7	8–10	0–10	%
									56.8	+3.5							59	2.40	+.4															6.6	
Billings [3]	3,570	16	39	889.3	1,012.0	−1.2	73	45	59.1	+3.0	88	27	31	23	216	38	52	1.53	.....	.63	12	5	T	0	10.4	sw.	52	n.	20	8	6	17	6.2	68
Butte	5,533	44	58	829.0	1,015.3	.....	65	35	49.9	+2.5	81	26	22	6	468	33	59	1.74	.0	.62	13	11	.2	0	9.9	nw.	.....	.....	.....	6	5	20	7.2	..
Glasgow	2,086	34	53	938.0	1,011.9	.....	76	46	60.8	+5.1	94	28	30	6	202	37	47	1.39	−.5	.72	7	5	T	0	.....	.....	.....	.....	.....	7	9	15	6.4	..
Great Falls [3]	3,657	16	75	886.6	1,013.0	.....	69	45	56.8	+2.2	84	10	30	5	275	34	50	3.21	+1.0	1.67	10	3	5.4	0	11.9	sw.	61	nw.	17	10	3	18	6.1	70
Havre	2,507	11	67	924.5	1,012.5	−.7	74	46	59.6	+6.2	89	10	33	23	202	.....	.....	2.71	+.7	1.65	7	2	T	0	8.4	sw.	34	w.	27	9	8	14	6.2	71
Helena [3]	4,124	5	43	872 3	1,013 8	− 1	69	40	54 7	+3.1	84	12	25	6	318	37	57	2.18	+.2	.58	13	6	.6	0	8.1	w.	37	se.	27	8	6	17	6.4	63
Missoula [3]	3,263	4	32	900.1	1,013.6	−1.6	71	42	56.2	+4.0	89	26	27	5	277	39	59	1.71	.0	.64	12	7	.0	0	5.9	nw.	29	ne.	13	8	6	17	6.6	62
Kalispell	2,973	48	56	910.3	1,012.9	−.6	70	44	57.0	+5.6	87	12	30	4	261	.....	.....	1.22	−.2	.46	9	3	.0	0	.....	.....	.....	.....	.....	11	3	17	6.1	..
Miles City [3]	2,371	5	28	928.9	1,012.3	−1.6	75	47	60.9	.....	92	27	32	1	190	42	..	1.32	.....	.65	8	5	T	0	8.9	sse.	.....	.....	.....	7	9	15	6.2	..
Rapid City [3]	3,259	5	56	901.1	1,012.9	−1.3	70	45	57.4	+3.4	84	28	31	24	254	44	63	1.63	−1.3	.72	9	10	.2	0	13.8	.....	43	s.	28	7	8	16	6.7	63
Cheyenne [3]	6,094	22	40	810.4	1,012.3	+.8	63	40	51.8	+1.5	78	3	31	5	409	39	66	4.27	+1.8	1.58	13	14	T	0	11.1	.....	49	w.	20	2	11	18	7.6	52
Lander [3]	5,352	6	30	827.6	1,012.5	.0	66	41	53.7	+2.5	79	25	28	1	347	37	57	2.80	+.5	1.09	11	4	5.7	0	7.4	.....	40	sw.	3	6	9	16	7.0	58
Sheridan [3]	3,790	5	38	882.8	1,012.9	−.6	70	42	56.0	+4.0	84	12	29	1	279	41	60	2.83	+.2	.63	12	9	T	0	8.0	.....	43	nw.	17	5	13	13	6.3	57
North Platte [3]	2,821	11	51	915.3	1,012.3	−.9	72	51	61.2	+2.5	94	3	39	2	154	51	74	5.10	+2.3	1.91	16	13	T	0	10.6	.....	54	e.	20	5	6	20	7.2	51
MIDDLE SLOPE																																	6.8	
									65.4	+2.3							68	5.13	+1.5														6.9	53
Denver [4]	5,292	106	113	835.1	1,012.0	+.1	68	47	57.9	+1.7	86	3	34	6	236	38	56	2.92	+.7	.86	10	5	T	0	7.3	.....	39	s.	20	4	10	17	6.9	53
Pueblo [3]	4,690	5	36	855.1	1,011.4	+.2	75	47	60.8	+1.9	88	3	37	1	151	40	53	3.32	+1.7	1.20	9	5	1.8	0	7.4	.....	59	w.	20	6	13	12	6.2	65
Concordia	1,392	50	58	963.8	1,013.5	.0	74	57	65.6	+2.4	87	31	46	1	71	.....	.....	3.45	−.7	.84	11	8	T	0	.....	s.	27	sw.	18	9	3	19	6.7	55
Dodge City [3]	2,509	5	58	922.8	1,012.6	−.3	74	54	64.0	+.5	88	30	42	1	91	56	79	4.85	+2.0	1.67	13	13	T	0	13.7	.....	55	s.	20	4	13	14	6.7	64
Wichita [3]	1,358	52	64	965.5	1,013.4	+.5	76	58	67.2	+2.1	91	31	48	10	30	58	76	6.15	+1.7	1.51	14	13	T	0	13.9	.....	56	s.	4	4	12	15	7.2	50
Oklahoma City [4]	1,214	10	47	967.2	1,015.3	+2.8	81	62	71.4	+3.7	93	31	52	11	2	65	72	6.91	+2.0	2.02	15	8	T	0	8.5	s.	33	nw.	23	.....	.....	.....	.....	55
Tulsa [3]	674	10	60	989.5	1,013.8	.....	81	61	70.7	+3.5	93	31	50	11	7	61	74	8.34	+3.3	4.03	13	14	T	0	9.8	sse.	.....	.....	.....	4	7	20	7.3	57
SOUTHERN SLOPE																																	5.8	
									71.8	+1.5							65	3.80	+.7														6.3	64
Abilene [3]	1,755	4	59	952.3	1,012.2	+.7	83	63	73.0	+2.4	95	30	55	11	1	62	71	5.09	+1.1	1.76	7	10	T	0	13.1	sse.	73	n.	25	6	13	12	6.3	64
Amarillo [3]	3,604	5	42	887.9	1,012.1	+.2	76	53	64.8	+2.7	90	30	41	1	70	53	71	6.43	+3.6	4.35	12	16	T	0	12.9	s.	84	sw.	15	9	11	11	5.9	65
Del Rio	960	63	71	978.0	1,010.8	+1.0	87	70	78.2	+1.2	97	29	62	10	0	67	73	.40	−2.5	.22	5	6	0	0	10.5	se.	38	s.	23	5	11	15	6.8	58
Roswell	3,614	6	29	990.9	1,010.0	−.2	85	54	69.7	+.3	97	29	46	2	5	40	41	.75	−.3	.47	4	5	T	0	9.9	n.	42	sw.	4	15	8	8	4.1	73
Wichita Falls	1,030	4	49	976.6	1,012.8	.....	84	63	73.2	+.9	101	30	53	10	1	62	70	6.35	+1.7	1.93	10	13	T	0	13.5	s.	.....	.....	.....	9	11	11	5.8	..
SOUTHERN PLATEAU																																	3.0	
									69.4	+1.2							30	.54	+.2														2.8	93
El Paso [3]	3,916	35	85	883.8	1,008.7	+.2	86	58	72.5	+2.5	95	25	50	9	0	34	28	.39	+.1	.18	4	5	0	0	11.0	s.	59	ne.	10	21	8	2	4.3	79
Albuquerque [3]	5,314	5	45	835.8	1,009.1	.0	78	51	64.8	+1.5	88	25	45	6	63	32	34	1.35	+.8	1.06	4	5	0	0	10.3	ssw.	42	e.	6	14	10	7	4.1	..
Flagstaff	6,907	34	48	789.4	1,013.8	+5.3	67	35	50.8	+.1	83	25	28	7	440	28	45	1.03	+.1	.59	4	2	5.8	0	6.4	.....	.....	.....	.....	16	8	7	.....	..
Phoenix [4]	1,107	39	87	970.9	1,009.2	+.7	91	62	76.8	+1.8	106	24	54	21	0	36	26	.17	.0	.17	2	1	.0	0	7.1	.....	26	w.	14	19	6	6	2.7	96
Tucson [3]	2,555	5	39	922.8	1,009.3	+.5	89	57	73.4	+.2	104	25	49	21	0	26	19	.00	−.2	.00	0	0	.0	0	8.5	.....	29	sw.	29	22	5	4	2.3	93
Yuma	142	9	54	1,004.4	1,009.5	+.7	93	64	78.4	.....	108	24	55	20	0	41	30	.32	.....	.32	1	1	.0	0	7.9	.....	35	nw.	19	23	5	3	2.0	93
MIDDLE PLATEAU																																	6.5	
									56.6	+2.3							51	1.60	+.5														7.0	62
Ely [3]	6,262	8	41	807.3	.....	.....	64	36	50.0	+2.1	80	26	26	5	464	.....	.....	1.53	+.1	.41	12	10	T	0	11.5	.....	45	se.	9	6	9	16	7.0	67
Reno [3]	4,527	20	52	864.2	1,013.0	+.1	72	38	54.7	+1.8	91	26	28	6	323	37	55	1.64	+1.0	.80	9	3	T	0	7.5	.....	45	s.	14	9	8	14	5.8	67
Winnemucca	4,339	5	56	865.6	.....	.....	72	43	57.4	+3.5	90	25	30	5	256	.....	.....	1.44	+.6	.55	11	5	.0	0	7.8	.....	38	s.	14	6	7	18	6.6	49
Salt Lake City [3]	4,357	32	58	868.3	1,010.8	+1.7	72	48	60.1	+4.4	88	26	37	20	177	40	52	2.66	+.9	1.04	12	10	.0	0	10.2	.....	35	nw.	9	7	8	16	6.6	71
Grand Junction [3]	4,602	5	26	858.1	1,012.1	+1.9	74	48	61.0	−.1	85	26	40	8	140	36	45	.74	−.1	.19	12	9	.0	0	7.7	.....	56	nw.	24	7	8	16	6.4	59
NORTHERN PLATEAU																																	5.6	
									59.4	+4.5							55	1.14	−.3														5.5	
Baker [4]	3,471	36	54	894.0	1,013.8	−1.8	70	42	55.9	+4.2	89	26	28	4	292	40	..	1.11	−.4	.30	10	4	T	0	6.2	se.	21	sw.	2	10	9	12	5.5	..
Meacham	4,056	7	28	875.7	1,012.7	.....	63	41	51.9	.....	81	25	27	4	409	40	66	1.96	.....	.59	10	6	T	0	5.4	wnw.	.....	.....	.....	.....	10	5	16	6.2	..
Boise [3]	2,739	5	49	916.4	1,011.4	−2.5	75	48	61.5	+5.4	94	26	29	1	172	41	57	.73	−.7	.24	8	6	.0	0	9.6	se.	35	nw.	2	7	12	12	6.3	64
Lewiston	1,436	4	23	961.1	1,012.4	.....	74	49	61.8	.....	92	12	33	4	158	46	59	1.56	.....	.51	12	5	T	0	5.4	s.	.....	.....	.....	.....	10	7	14	5.6	..
Pocatello [3]	4,478	5	31	860.5	1,011.9	−.3	72	44	57.8	+4.8	85	26	35	6	227	40	55	2.03	+.3	.55	12	9	T	0	9.1	ssw.	45	ne.	10	5	12	14	6.6	57
Ellensburg [3]	1,735	5	58	951.9	1,013.9	.....	74	44	59.1	+3.6	91	12	29	5	215	39	51	.30	−.3	.12	4	0	.0	0	14.0	nw.	.....	.....	.....	13	9	9	4.5	..
Spokane [3]	1,929	6	51	944.8	1,013.3	−1.3	72	47	59.1	+3.6	90	11	30	4	229	38	50	.90	−.5	.46	9	1	.0	0	7.1	ssw.	25	sw.	16	11	6	14	5.6	65
Walla Walla	991	57	65	977.7	1,013.5	−1.4	76	54	64.7	+5.1	90	11	39	5	106	45	..	1.49	−.3	.80	10	1	.0	0	5.4	s.	25	sw.	2	12	11	8	4.7	65
Yakima [3]	1,076	4	54	974.3	1,013.1	−1.8	80	46	62.7	+4.5	98	12	30	4	150	39	44	.14	−.3	.07	3	0	.0	0	8.3	w.	.....	.....	.....	11	9	11	5.1	..

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR MAY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Temperature of the air: Averages: Mean minimum	Temperature of the air: Averages: Mean	Temperature of the air: Averages: Departure from normal	Temperature of the air: Extremes: Highest	Temperature of the air: Extremes: Date	Temperature of the air: Extremes: Lowest	Temperature of the air: Extremes: Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Character of day (sunrise to sunset), number of days: Clear	Character of day (sunrise to sunset), number of days: Partly cloudy	Character of day (sunrise to sunset), number of days: Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
NORTH PACIFIC COAST	*Fl.*	*Fl.*	*Fl.*	*Mb.*	*Mb.*	*Mb.*	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	*In.*	*In.*	*In.*			*In.*	*In.*	m. p.h.					0-3	4-7	8-10	0-10	%
									57.5	+3.3							69	1.80	−.4															6.7	
Kelso [2]	750	38	76				70	44	56.8																									
North Head	211	5	55	1,008.8	1,016.3	−2.3	58	48	53.2	+2.3	82	6	40	4	368			1.67	−1.3	1.18	14	0	T	0	12.6	nw.	35	s.	1	2	8	21	7.9	47
Seattle [4]	125	90	321	1,011.2	1,016.2	−1.4	60	49	59.1	+2.5	81	11	41	3	187	46	67	1.35	−.5	.77	5	0	T	0	6.8	s.	36	sw.	2	7	12	12	6.0	61
Tacoma	194	172	201	1,009.1	1,015.9	−1.7	67	48	57.8	+3.7	78	18	38	4	225			1.28	−.8	.76	9	0	T	0	8.0	n.	29	sw.	2	11	8	12	5.4	66
Tatoosh Island	86	5	61	1,013.2	1,016.6	−1.4	56	47	51.6	+2.0	67	17	41	4	412	46	84	1.98	−2.0	.66	12	0	.0	0	11.6	s.	44	ne.	6	6	6	19	7.3	55
Burns	4,162	35	47	871.3	1,013.0		70	43	56.4	+5.5	88	25	29	5	277	37	52	.70	−.1	.23	12	6	T	0						3	10	16	6.8	
Eugene [2]	433	4	35	1,002.7	1,016.3		71	46	58.5		86	12	33	4	209	48	73	2.65		1.49	7	1	.0	0	7.1	n.				7	6	18	6.9	
Medford [2]	1,329	29	58	967.8	1,015.5	−1.1	74	47	60.2	+2.0	92	11	33	4	170	45	62	1.74	+.6	.69	9	4	.0	0	6.2	nw.				6	8	17	6.5	
Portland, Oreg. [4]	154	68	106	1,010.8	1,016.2	−1.4	71	52	61.3	+4.4	88	12	40	3	147	47	70	2.77	+.6	1.46	9	0	.0	0	5.8	nw.	19	ne.	6	7	7	17	6.6	52
Roseburg	510	45	76	997.6	1,016.1	−1.9	72	48	60.2	+4.2	89	12	35	4	167	47	69	1.96	.0	1.24	10	2	.0	0	4.7	n.	16	sw.	2	6	8	17	6.7	49
MIDDLE PACIFIC COAST																																		
									60.7	+1.1							63	1.39	+.3															5.6	
Eureka	60	72	88	1,015.6			58	49	53.6	+1.6	78	6	41	5	352			2.56	+.8	1.93	7	0	.0	0	7.6		32	nw.	16	3	8	20	7.8	52
Red Bluff [2]	353	5	26	1,000.7	1,013.3		81	56	68.0	+1.7	98	25	45	3	43	45	50	1.74	+.6	.53	11	8	.0	0	8.5		29	se.	10	12	6	13	5.1	75
Sacramento [4]	66	92	115	1,011.5	1,014.1	+.6	77	52	64.4	+1.1	94	25	45	4	69	48	61	.32	−.4	.20	3	1	.0	0	7.9		26	sw.	17	14	10	7	4.0	81
San Francisco	155	112	132	1,015.2	1,016.0	+.4	62	51	56.7	−.1	85	6	48	4	269	48	78	.93	+.1	.50	4	2	.0	0	10.5		38	w.	17	8	14	9	5.4	62
SOUTH PACIFIC COAST																																		
									65.3	+1.7							62	.42	.0															5.0	
Fresno [2]	327	5	34	1,001.7	1,013.8	+.5	83	54	68.6	+1.4	100	25	46	4	22	46	50	.39	.0	.35	3	2	.0	0	8.2		31	nw.	2	17	6	8	3.8	84
Los Angeles	338	236	263				74	55	64.3	+2.1	90	23	49	20	76			.46	.0	.28	5	0	.0	0	6.2		25	w.	6	12	8	11	5.3	60
San Diego [2]	87	20	55	1,011.5	1,014.6	+1.4	70	56	63.0	+1.7	83	6	51	4	74	53	73	.41	+.1	.16	6	0	.0	0	7.1		23	s.	18	10	8	13	5.9	56
West Indies																																		
San Juan, P. R.	82	9	34	1,012.5	1,015.2		83	74	78.6	.0	89	10	70	5	0			5.68	+.4	2.05	13	1	.0	0	11.3	e.	32	e.	4	3	17	11	6.8	60
Alaska																																		
Anchorage [2]	132	6	44	1,009.1	1,014.2		54	35	44.8	−.2	68	26	20	4	627	32	62	.41	−.1	.21	5	0	3.9	0	6.0	w.	24	s.	11	5	8	18	7.2	
Annette Island	113	5	53	1,012.9	1,016.9		56	43	49.5	−.9	69	19	32	3	480	42	78	4.98	+.8	2.02	14	0	T	0	8.9	se.				5	6	20	7.6	
Barrow	29	5	27	1,020.0	1,021.0		22	11	16.3	−3.0	35	26	−13	3	1,510	12	82	.16	.0	.07	7	0	1.9	12		ene.	23	ne.	22	1	3	27	9.1	
Bethel [2]	28	5	31	1,013.5	1,015.2		41	26	33.8	−6.2	64	31	−5	2	970	30	84	.61	−.3	.33	9	0	.3	0	8.0	nw.				2	6	23	8.4	
Cordova [2]	45	5	32	1,012.9	1,014.6		51	33	42.2	−1.4	65	18	20	4	707	36	82	5.57	−1.2	1.15	17	0	18.5	T		se.	27	ene.	12	6	8	17	7.0	
Fairbanks [2]	455	5	63	996.6	1,014.2		55	33	44.0	−2.9	76	31	17	5	653	35	72	.52	−.1	.19	10	0	1.0	0		wnw.	30	sw.	12	7	8	16	7.0	
Galena	139	4	66	1,009.5	1,014.2		48	29	38.6	−3.5	72	31	−1	6	821	28	66	.81	−.4	.26	9	0	3.7	0		n.				8	3	20	7.1	
Gambell	32	5	32	1,013.9	1,014.9		29	24	26.4	−3.1	38	20	2	1	1,197	24	91	1.87	+1.3		15	0	6.4	2	14.0	nne.	40	e.	19	1	6	24	9.0	
Juneau [2]	80	6	30	1,015.6	1,016.6		55	37	45.8	−1.0	72	20	26	1	596	37	76	3.38	+.4	.92	17	0	T	0		ese.	26	se.	3	6	3	22	7.4	
Kotzebue [2]	20	5	31	1,015.2	1,015.9		32	19	25.6	−4.1	51	28	−12	6	1,223	22	86	.80	+.5	.30	10	0	.9	T		w.				7	4	20	7.5	
McGrath [2]	341	5	31	1,001.7	1,014.6		50	30	39.8	−3.4	73	31	−1	5	780	30	68	.49	−.5	.37	6	0	1.3	0	4.9	wnw.				3	8	20	8.1	
Nome [2]	22	10	75	1,014.6	1,015.2		36	23	29.2	−4.9	57	29	−11	2	1,108	26	85	.79	+.2	.22	11	0	2.0	1		e.	30	nw.	1	4	4	23	8.4	
Northway [2]	1,718	5	32	950.6	1,014.2		54	31	42.3	−3.1	72	21	10	5	702	29	65	.65	.0	.28	9	0	T	0		nw.				2	8	21	8.0	
Hawaii																																		
Honolulu [4]	38	86	98	1,016.9			79	70	74.5	−.3	82	18	67	9	0			.06	−1.7	.02	5	0	.0	0	8.6		23	e.	6	10	10	11	5.9	60

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations, according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport, remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE STORMS FOR MAY 1949

The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Eagle Gap, Ark.	Apr. 30–May 1	Night				Wind and hail	Extensive damage to roads, timber, farm houses and outbuildings.
Vandervoort and Cove, Ark.	Apr. 30–May 1	do				Wind	Several barns, outbuildings and 2 houses destroyed.
Russellville, Ark.	Apr. 30–May 1	do				do	Destroyed 1 house.
Ratcliff, Ark.	1	Morning				do	Trees and 3 houses damaged.
Dickson, Tenn.	1	11:45 a. m.	400	0		Tornadic winds and rain.	Approximately 50 houses and 1 factory building damaged, and many early gardens ruined. Windows broken, roofs damaged, trees twisted and broken, and electric service disrupted. Storm lasted 5 minutes.
Pulaski, Tenn.	1	Noon	50	0	$75,000	Tornado and rain	Seed processing plant suffered severe damage; 2 buildings unroofed, equipment of processing plant severely damaged, grain elevators completely destroyed, and stock of processed seed damaged. Path of storm approximately 300 yards in northeastward direction.
Mt. Pleasant, Tenn.	1	do	500	0		do	Storm lasted about 10 minutes. Winds estimated up to 75 m. p. h. Every power line in town was out for a short period of time. Falling limbs and trees damaged about 15 homes and buildings. Length of path about 12 miles in northward direction.
Mishawaka, Ind.	1	4:10 p. m.	100		75,000	Wind	Severe line squall.
Chickasaw County, Miss.	1	Late afternoon		0	25,000	Tornado	Passed over sparsely settled areas north of Houston to near Okolona; damaged several homes, numerous trees. No personal injuries.
Water Valley, Miss.	1	do		0	100,000	do	Details lacking, but apparently no serious injuries.
Jacksonville, Fla.	2	2:30–3 p. m.			2,000	Electrical, wind and hail.	Gusty winds broke plate glass store window. Garage partially unroofed. Lightning struck garage causing damage to structure and contents estimated at $700. Electric distribution equipment damaged by lightning at several points. Light hail fell in several sections.
Chaves County (southern portion), N. Mex.	3	3–5 p. m.			3,500	Hail	Some damage to cotton and alfalfa.
Brainerd and vicinity, Minn.	3	4–6 p. m.	16	0	32,000	Thundersqualls (possibly small tornado).	Many buildings either moved from foundations, unroofed, or otherwise damaged: awnings, signs and billboards blown away; 2 steel light towers at baseball park wrecked; fences, score board, and press box demolished and grandstand damaged; poles and wires down; several airplanes at airport blown off field and 1 damaged extensively; trees uprooted.
Brainerd and vicinity, Minn.	3	4–6 p. m.			5,000	Hail	Heavy hail, accompanying severe thunderstorm, resulted in many broken windows; greenhouses, roofs, neon signs, and automobile tops damaged. Some damage to growing crops.
Greeley, Wichita, and Scott Counties, Kans.	3	Late afternoon				do	Hail fell along several paths over northern portion of these counties, at intervals in general storm. Some hailstones as large as hens' eggs and driven several inches into ground. Wheat losses ranged from 10 percent to total. Little property damage.
Northern Roosevelt and southern Curry Counties, N. Mex.	3	Late afternoon and evening				Rain and hail	Considerable damage to young crops from washing, and to winter grains by hail
Moose Lake and vicinity, Minn.	3				500	Electrical	3 homes damaged by lightning.
Vicinity of Lake Superior in northwestern Wisconsin.	3–5			1	100,000	Thunderstorms	High winds blew down trees, disrupting power and communication service; demolished about 20 farm buildings. Accompanying heavy rains caused minor floods, washing out 3 small bridges and damaging highways. Man drowned in harbor at Superior when small boat capsized.
Flamingo, Fla.	4	Afternoon		1		Electrical	65 miles southwest of Miami lightning struck tent in which 4 persons were seeking shelter, killing 1 instantly and injuring the others.
Chaves County (southern portion), N. Mex.	4	4 p. m.			5,000	Hail	Cotton destroyed.
Portales and vicinity, N. Mex.	4	5:30 p. m.			125,000	Hail and wind	Crops destroyed, and about $75,000 damage to buildings and other property.
Underwood and vicinity, Minn.	4	5:30–6 p. m.			5,000	Hail	Heavy hail, accompanying severe thunderstorm, caused considerable damage to real property and some damage to growing crops. Some young pigs and poultry killed.
Richwood Township, Becker County, Minn.	4				2,500	Thundersqualls	Barn blown down, and some minor damage to buildings on several farms.
Thomas, Rawlins, and Decatur Counties, Kans.	5	5 p. m.	[1]5		150,000	Hail	Storm originated in northwestern Thomas and southwestern Rawlins Counties, progressed northeastward across Rawlins County and into Decatur County. Total path of destruction, about 60 miles. Stones as large as goose eggs and golf balls fell in some areas. Storm appeared to separate into 3 paths over northern Decatur County. Some wheat fields a total loss.
Ettrick and Trempealeau, Wis.	5	7:30 p. m.			10,000	Thunderstorm	Trees blown down and several farm buildings demolished. 1 person injured.
Fillmore County, Nebr.	5	8:30–9 p. m.	[1]1 to 2		35,050	Hail	Damage to crops $35,000; other property $50. Damaged wheat and alfalfa. Storm described as splitting, 1 part moving northeastward from Geneva and the other southeastward. Path 6 to 10 miles long.
Sedan and vicinity, Nuckolls County, Nebr.	5	P. m.	[1]3		2,000	do	Alfalfa, oats, and wheat damaged. Path 4 to 5 miles long.
Dalhart, Tex.	5		200	0		Tornado	Chicken house demolished; about 100 chickens killed.
Rawlins to Rock Springs, Wyo.	5					Snow	Highway 30 blocked. Many travelers stranded.
Chaves County (southern portion), N. Mex.	6	2 p. m.			10,000	Hail	Cotton damaged.
Havana, Gadsden County, Fla.	6	Afternoon			150,000	do	Hail virtually destroyed 250 acres of shade tobacco.
Bledsoe, Tex.	6	5 p. m.	1,320	0		Tornado and hail	2 houses and 1 car demolished.
Sundown, Hockley County, Tex.	6	5:45 p. m.	14[7]	2	350,000	do	About 20 homes and other buildings destroyed and unroofed. 10 cars and trucks demolished. 2 cows received broken legs. Enormous amount of glass damage. 3 persons injured.
Charles Town and vicinity, W. Va.	7	2:30 p. m.	[1]2			Hail and rain	Hailstones ½ inch in diameter severely damaged all crops and shattered many glass windows.
Mulberry, Ark.	7	Afternoon				Hail and wind	Damaged gardens and field crops.
Timberville, Va.	7	Late afternoon			150,000	Electrical	Large feed supply store burned.
Portsmouth, Va.	7	6:25 p. m.				Wind	Revival tent blown down; 6 persons injured, 1 seriously.
Baltimore County, Md.	7	P. m.				Hail and wind	Damage to strawberries and wheat; 2 trees uprooted.
Washington County, Md.	7	P. m.				Hail	Damage to tender garden crops.
Talbot County, Md.	7	P. m.				Wind and thunderstorm.	Trees blown down.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Shirley, Ark	7	Night				Hail	Considerable damage to gardens.
Milton, Fla	8	2 p. m				do	Moderate to heavy hail damaged growing crops to some extent.
Jacksonville, Fla	8	3:45 p. m			1,000	Electrical and wind	Thunderstorm to west of city with winds estimated to have reached 70 m. p. h. at Herlong Field where 4 airplanes and an automobile damaged; the damage to car due to wind blowing ¾-ton truck against it. Lightning struck a parked car on which 4 people were standing at Jacksonville Speedway, but caused no damage and only minor injuries.
Cape Sable, Fla	8	Afternoon		1		Electrical	Woman sitting in tent killed by lightning.
Grandfield (near), Tillman County, Okla.	8	5–6 p. m	880–3,520		500,000	Hail	One area southwest and another east of Grandfield. Damage to wheat and some alfalfa.
Kansas City (southeastern edge of), Mo.	8	5:30 p. m	50–100	0	1,500	Tornado	Slight damage to house and barn, and some trees blown down. On another farm, barn moved about 75 feet and set down in bad condition. Several trees blown down nearby and other minor damage. Except for some other trees blown down and limbs twisted, no further evidences of tornado.
Schulter, Pittsburg County, Okla.	8	6:30–6:35 p. m	880	0	30,000	Tornado and hail	Path 5 miles long. No injuries. Storm from southwest turned and left town in southeastward direction. Hail damage $20,000 to crops; tornado damage to buildings, $10,000.
Newport, Ark	8	Night				Hail	Considerable damage to spinach crop in southern Jackson County.
Coalton-Nokomis area, Ill	9	12:30 p. m			2,000	do	Hailstones up to 1 inch in diameter damaged a number of gardens and some wheatfields.
Cape Girardeau County, Mo.	9	2 p. m	[1] 1			Thunderstorm and hail.	Hail did considerable damage to gardens and fruits near Gordonville and Pocahontas. Some damage to hay-crops and windows. Some replanting of crops and gardens necessitated.
St. Louis County (extreme northeastern portion), Mo.	9	2:30 p. m		0		Tornado	Trees uprooted and section of barn blown into Missouri River by a small tornado which struck Columbia bottoms area near confluence of Missouri and Mississippi Rivers.
Columbia, S. C	9	2:47–10 p. m		1	3,000	Electrical	Woman killed by lightning and her house burned. Other minor damage caused by wind squalls.
Jonesboro, Ill	9	3:30 p. m	[1] 1		15,000	Hail	Considerable damage to tree fruits and other crops.
Albermarle County, Va	9	4:30–6 p. m			300,000	Hail and wind	Several buildings unroofed, poultry killed, crops cut to pieces over 12 square miles or more. Estimated 200,000 bushels of fruit destroyed. Considerable damage to crops over small area.
Greene County, Ind	9	5 p. m	[1] 3		26,000	do	Stones up to 1 inch diameter. Heavy hail caused some roofs to cave in. $25,000 crop damage included in total.
Nashville, Tenn	9	6:20 p. m				Electrical and hail	Electric and telephone services disrupted over wide area. Several fires and traffic accidents. East Nashville and north Davidson County felt the whiplash of hail in early afternoon. Violent lightning bolts caused nearly all damage and interruption to utilities. Belle Meade hard hit and numerous trees toppled in the area.
Lawrence County, Ind	9	7 p. m	[1] 5		22,000	Wind and hail	Stones up to ¾ inch diameter. $18,000 crop damage included in total.
Elephant Butte and vicinity, N. Mex.	10	1 p. m			5,000	Hail and wind	Some fruit damaged; principal damage to buildings and cars.
Albany, Ga	10	2:30 p. m			2,000	Wind	Winds, reaching force of 60 m. p. h., caused widespread damages; plate glass windows and window panes broken; many trees blown down or delimbed, blocking streets and causing damages to other property; power and telephone lines blown or torn down, disrupting services 3 to 4 hours; house roofs damaged to some extent; a large sign board torn from its moorings; and skating rink blown over, injuring 1 person. No damage to crops other than some corn blown down.
Everglades National Park, Fla.	10	2:45 p. m		0		Tornado cloud	Cloud 5 miles northwest of Royal Palm Ranger Station; did not reach ground.
Catawba, Cabarrus, Cleveland, Iredell, Burke, Rowan, and Rutherford Counties, N. C.	10	Late afternoon				Hail and wind	Hailstones reported at some places size of hens' eggs. Heavy damage to crops and some damage to buildings.
Polkton, Anson County, N. C.	10	do		2		Electrical	Children were apparently touching metal clothes line attached to tree that was struck. No property damage reported.
Wauchula, Fla	10			1		do	Man killed by lightning.
Carpenter, Wyo	10					Hail	Slight damage to alfalfa.
Fruitland and vicinity, N. Mex.	11	2:10 p. m			500	do	Gardens and fruit damaged.
Carpenter, Wyo	11					do	Slight damage to growing crops.
Fort Lupton, Colo	12	3:45 p. m		1		Rain and electrical	Woman struck by lightning while standing under large tree. 2 others injured, but not seriously.
Roseau and vicinity, Minn	12	9:15–10 p. m				Thundersqualls	Slight damage to farm buildings, machinery and power lines. Storm moved southeastward. Moderately heavy rains, lightning, and hail caused slight damage.
Sherman County, Kans	13	3:45–6 p. m	[1] 3–4			Hail and tornado	Hail fell over strip 15 miles long. Some wheat suffered 100 percent loss. 4 distinct tornado funnels observed. 2 reached ground. Tornadoes originated 7 miles north and 4 miles east of Goodland and disappeared 7 miles north of city, moving almost due west. Fences destroyed.
Potter and Carson Counties, Tex.	13	4:55 p. m	17	0	16,500	Tornado, with hail	Formed 10 miles northeast of English Field and moved northeastward to town of Panhandle. Heavy hail, average size 4 inches in diameter; 1 stone measured 8½ x 5½ inches and weighed 4½ pounds, 45 minutes after storm. Part of path above ground; most of path in open country. Believed to be same storm that hit Panhandle, Tex.
Panhandle, Carson County, Tex.	13	5 p. m	17	0	41,100	do	Heavy hail damage to wheat, estimated at $40,000. As tornado reached edge of town, it veered to left and then lifted, after damaging only 1 home.
Wisconsin Rapids and vicinity, Wis.	13	Afternoon			20,000	Thunderstorm	2 dairy barns demolished, and several smaller farm buildings damaged.
Hagerman and vicinity, N. Mex.	13	P. m				Hail	Difficult to assay damage of any one storm in this area, as there had been several during the latter part of April and early May. Cumulative damage to crops over this period estimated around $200,000. Many windows broken and roofs damaged.
Ringgold, Tex	14	5:30 p. m	[1] 8		400,000	Wind and hail	Estimated $300,000 hail damage to wheat, oats, corn, and cotton. Many farm and town residences need reroofing.
Ellis County, Kans	14	7 p. m	440		50,000	Hail	Storm moved northeastward along a path 4 miles long. Stones mostly small.
Weld County, Colo	14–18				1,500,000	Rain, hail, and wind	Storm general over county, severe in southern portion. Caused damage to crops, livestock, farm lands, and roads. Land inundated; bridges and grades washed out.
Stuart, Va	15	11:10 a. m.–12 noon.				Hail	Considerable damage to crops over small area.
Pueblo, Colo	15	11:25 a. m.–5:35 p. m.			500	Hail, rain, and lightning.	Damage mostly to truck crops.
Keenesburg (near), Colo	15	2–4 p. m	300		10,000	Wind, hail, and rain	Principal damage to crops and building roofs.
Briggsdale (near), Colo	15	3:30–6 p. m	[1] 10		2,000	Rain and hail	Damage to crops, livestock, and power lines.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Dumas, Tex.	15	4:30 p. m.		0	500,750	Tornado and hail	Tornado damage light; confined to trees, 2 barns, and some residences. Hail damage to wheat estimated at $500,000.
Medicine Bow, Wyo.	15	Afternoon				Electrical	Slight damage when lightning hit building.
Gruver, Tex.	15	6 p. m.		0		Tornado and hail	Several thousand acres of wheat severely damaged by hail. One home unroofed; several windmills blown away; metal granary moved ¼ mile; trees uprooted.
Amarillo, Tex.	15	6:30 p. m.	147	6	5,310,000	do	Total destruction over 1 block by 3 blocks; all persons killed, lived in same block; 83 injured. 15 known farm homes and buildings, airport and 45 planes damaged; 28 boxcars blown off track; heavy damage over 1¼ mile area and light damage over considerable area. Building and a roof damaged at Fair Grounds, 2½ miles from heaviest damage. Warehouse and 35 combines just west of English Field damaged; power and telephone lines along 3 railroads damaged, 1 CAA tower completely lost. Totally destroyed 35 automobiles. Tornado damage estimated at $4,779,000; wind damage, $318,600; hail damage, $212,400.
Woodward (near), Okla.	15	9:30–9:35 p. m.	67	0	1,100	Tornado	Farmstead 3 miles southwest of Woodward damaged. Northward path 3 to 4 miles long. Fire siren sounded and most persons went to storm cellars.
Sedgwick County, Kans.	15	Evening				Hail and wind	Considerable wheat and alfalfa damaged by hail, ranging in sizes from peas to golf balls.
Pawnee County, Kans.	15	11:30 p. m.		0		Tornado	Miniature twister apparently struck only 1 farmstead, 1 mile east of Larned, doing minor damage.
Denver (20 miles southeast), Colo.	16	3:30 p. m.		0		do	Observed from Denver, in isolated section; little damage resulted.
Power County, Idaho.	16	3:40–4:20 p. m.	[1] 3			Rain	1.40 inches rain recorded at American Falls in 40 minutes. Some topsoil washed on steep hillsides, with small loss in winter wheat on 2 or 3 farms in vicinity of Neeley.
Appling County, Ga.	16	Afternoon			15,000	Wind and hail	3 sections of county affected, heaviest damage south-central near Surrency, where home heavily damaged by high winds; many power and telephone lines down and other miscellaneous property damage. Hail, varying in size from small marbles to hens' eggs, caused heavy losses to crops, chiefly corn and tobacco, in the Surrency area; also, in areas near the Altamaha River and near Bacon County line. Losses probably amounted to $5,000 to property and $10,000 to crops.
Stuart, Guthrie County, Iowa.	16	Late afternoon		0		Tornado	Swept through 4-block area in northern part of Stuart, wrecking a church, damaging 1 home and 5 barns. Dozens of trees leveled. Estimated 3 inches of rain accompanied storm. No personal injuries reported.
Wichita County, Kans.	16	10 p. m.	440		25,000	Hail	Northeast of Leoti over path 2 miles long. Many stones 2 inches in diameter.
Texas County, Okla.	16	11:30 p. m.	50–75	1	13,000	Tornado, hail, and rain.	1 farm home demolished. Storm apparently originated southwest of Stratford, Tex.; moved to about 3 miles northwest of Goodwell.
Sun River, Mont.	16–17					Wind	Electric power lines damaged by falling trees.
Willard, Box Elder County, Utah.	17	4–8 a. m.	8,000			Flash flood	Following local heavy rains, a deluge of water poured out of several canyons over adjacent farm lands and orchards, cutting gullies. Silt and rock deposited on highway, stopping traffic for about 5 hours. Estimates of damage range from several thousand to $100,000, mostly to orchards and farm lands.
Harmon and Greer Counties, Okla.	17	12:05–2 p. m.			110,000	Hail and wind	Damage to wheat nearly ripe in area 5 x 10 miles in east-central Harmon County. About 15 farms affected in Greer County, south of Mangum.
Meade, Gray, Ford, and Jetmore Counties, Kans.	17	1–4 p. m.	[1] 5	1	902,000	do	Path began about 7 miles north of Plains with high wind. Hail and wind caused much wheat loss in southern Meade County and in Gray County near Ensign. Continued northeastward into western Ford County, ending in southern Hodgeman County. 1 death result of shed being blown over. Path 60 miles long.
Norton County, Kans.	17	1:30 p. m.			15,000	Hail	Stones size of golf balls. Storm occurred from 4 miles north and 1 mile east of Norton to near Nebraska line. Principal loss to crops.
Amery (near), Wis.	17	2:30 p. m.	50	0		Tornado	Path northeastward for about 8 miles, touching ground at 6 places. Buildings damaged on several farms, and a path cut through a woodlot. No personal injuries.
Lexington (south of), Dawson County, Nebr.	17	2:30–4 p. m.	[1] 2–4		9,950	Hail	Damage to alfalfa and wheat. Path 20 miles long.
Naponee (near), Franklin County, Nebr.	17	3:45–4 p. m.			500	Hail and wind	Wind caused most of damage to farm buildings.
Leicester Township, Clay County, Nebr.	17	5 p. m.	400–800	0	105,500	Tornado	Poultry blown away, buildings in path demolished or weakened, windmills and fences blown over. Damage to buildings, etc. $100,000; to poultry $2,500; crops in storage $3,000; slight damage to crops in fields from rain and light hail. 5 injured.
Butte (southeast and east of), Boyd County, Nebr.	17	5:30–5:45 p. m.	170	0	10,200	do	Killed chickens, smashed autos, tore down barns and other buildings. No stock or crop loss.
Spur, Tex.	17	5:45 p. m.		1	75,000	do	12 farm homes wrecked; damage to several wheat fields. 8 persons injured.
Caddo County, northern part, Okla.	17	6:20 p. m.	300	0	37,000	do	No injuries. Path 6–7 miles long. Tornado traveled from a point 4–5 miles southeast of Binger northward to point 4/5 mile northeast of Binger where 9 homes and 1 church blown away. From there it moved northwestward 2–3 miles, then in northerly direction.
Superior (west of), Nuckolls County, Nebr.	17	7–7:30 p. m.	880		7,000	Hail	Damaged alfalfa and wheat; windows broken. Path 2 miles long.
Hastings (near), Adams County, Nebr.	17	7:45–8 p. m.	[1] 1¾	0	250,000	Wind and hail (tornadic characteristics).	Automobile tops damaged slightly, shingles broken, wood truss building roofs with corrugated asbestos roofing extensively damaged. Path 3½ miles long in northeastward direction.
Lincoln County, Okla.	17	7:59 p. m.	200	0	110,000	Tornado	13 injured, mostly school students. School bus with children in it overturned. Probably 2 or 3 tornadoes close together, all moving northeastward. Several buildings, including schools and churches in eastern part of Meeker damaged or destroyed. Several farm homes damaged.
Haskell, Tex.	17		25	0	2,000	Tornado and hail	Small outbuildings destroyed, also 1 barn; 1 cow killed. All damage from tornado. Hail moderate, size of marbles to hens' eggs. Funnel cloud observed.
Labette and Cherokee Counties, Kans.	18	12:30–1:10 a. m.		0		Tornado and wind	Small tornado near Chetopa. High winds over southern Labette and Cherokee Counties. Plate glass broken, small buildings blown over, trees uprooted, and wheat blown down. A few larger buildings unroofed. Power lines broken and telephone service interrupted.
Dumas, Moore County, Tex.	18	12:30 p. m.	[1] 22		50,000	Hail	Difficult to estimate hail damage to wheat due to previous storm and light nature of this one. Three funnel-shaped clouds were observed, but none touched ground.
Cheyenne, Wyo.	18	1:35 p. m.				Tornado	Three tornado funnels sighted, but none reached ground.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Sherman, Cheyenne, Rawlins, Thomas, Sheridan, Decatur, and Norton Counties, Kans.	18	3:30 p. m. to midnight.	[1] 8	------	2,375,900	Wind and hail	A number of short paths occurred in connection with main storm, which began with high wind near Goodland. Hail damage extended from northern Sherman and southern Cheyenne Counties eastward along Rawlins and Thomas County line and into northern Sheridan County, thence across Sheridan into northern Norton County. Some buildings damaged and much wheat total loss. Roof and glass damage reported, and some loss of poultry and young livestock. Some stones as large as baseballs.
Cherokee County, Kans	18	Afternoon				do	Most damage in Columbus and area south a few miles. Some loss of crops. Hail size of golf balls damaged flat roofs especially.
Gould and vicinity, Okla	18	6:30–7:30 p. m	[1] 5	------	410,000	do	Path about 15 miles long; storm likely extended into Jackson and Greer Counties. Hail damage to wheat estimated at $350,000, to alfalfa, $30,000. 10,000 acres of wheat total loss, 15,000 acres partial loss. 9 buildings damaged or destroyed by straight wind, with $25,000 damage.
Harvey County, Kans	18	6:45 p. m		0	0	Tornado	Tornado did not come to earth.
Butler County, Kans	18	7:22 p. m		0	0	do	Tornado did not come to earth; observed for about 50 seconds, 12 miles northeast of El Dorado.
Altus (northwest of), Okla	18	7:30–8:15 p. m	[1] 15	0	200,000	Tornado and hail	Principal damage to wheat by hail at Duke. Tornado funnel seen near Altus moving northeastward. Storm path about 30 miles long. Victory and Friendship communities affected.
Norman and vicinity, Okla	18–19	7:30 p. m.–2:30 a. m.			500,000	Wind and rain	Nearly 8 inches of rain in a few hours caused severe damage to buildings, roads, etc. 75 percent of damage from rain.
Marshall County, Kans	18	8:30 p. m	100	0	500	Tornado	Baby twister originated just west of Marysville and jumped to northeastern section of town, demolishing cow shed.
Kiowa County, Okla	18	8:38 p. m	40	0	11,450	do	Funnel observed and reported; warning caused much confusion at Hobart. Struck Hobart airport, destroying hangar, then moved northward. Tornado missed Hobart.
Harper and Sumner Counties, Kans.	18	Evening		0	0	do	Several funnels observed near Wellington and Kiowa, none of which reached ground.
Panhandle, Carson County, Tex.	18					Hail	Heavy hail, largest size of silver dollar. Considerable damage to crops, but hard to estimate on account of previous hailstorms recently.
Wayne County, Ohio	18					do	Storm occurred a few miles south of Wooster. Hailstones found in fence rows to a depth of 12 inches. No crop damage reported as season early.
Craig County (northern part), Okla.	19	12:20 a. m	440	0	1,000	Tornado	1 injured. Path northeastward near Hollow, length not known.
Tulsa County, Okla	19	1–4 a. m	100	0	50,000	do	Several buildings unroofed in Broken Arrow, causing $25,000 damage. Several barns in surrounding area damaged or destroyed. Funnel cloud observed in Broken Arrow, as it moved southeastward in a quarter-mile path.
Joplin (western edge), Mo	19	1 a. m			4,000	Wind and thunderstorm.	Some trees blown over, limbs torn off others, a few buildings unroofed, signs torn down, wires damaged, and wall of building pushed in. 1 person slightly injured. 600 phones out and about 400 window panes broken; greenhouses the heaviest damage.
Mountainburg, Ark	19	Morning				Wind	Buildings unroofed and trees uprooted. Water plant damaged $1,000.
Northport (near), Morrill County, Nebr.	19	12:05–12:30 p. m.	300	0	5,750	Tornado and hail	Tornado damaged beets and small grain. Hail caused further damage to beets and hay. Crop damage $5,000; loss of baby chicks $50; damage to buildings $700. Path 4 miles long.
Waddington, N. Y	19	1:25 p. m				Wind	Northerly winds, estimated at 50 to 60 m. p. h. for 12 minutes, damaged shrubbery and gardens. Falling and broken trees brought down power lines which interrupted service for several hours.
Chase County, Nebr	19 and 23	5:30–7:25 p. m. 5:50 a. m.–7:40, p. m.	[1] 12½	0	2,345,000	Tornado and hail	Damage to wheat $2,250,000, other crops $65,000; to buildings from wind $30,000. Tornado occurred in southwestern Chase County.
Butler, Stoddard, Dunklin, and New Madrid Counties, Mo.	19	3:45–4:20 p. m	[1] ½–2	1	880,000	Tornado, wind, and hail.	Storm first reported at Rombauer and Fisk in northeastern Butler County, moved east-southeastward to Mississippi River about 5 miles south of New Madrid. Parma area hardest hit. According to Red Cross figures for entire area: A baby killed, 60 injuries; 49 homes destroyed, 287 damaged; 130 barns destroyed, 115 damaged. Other types of buildings destroyed numbered about 170, with about 180 damaged, besides damage to 12 business places, 2 churches, 1 school, and numerous power and phone lines. Crop damage and losses to livestock estimated at about $100,000 of the total loss; probably about $75,000 of that due to hail.
Joplin, Mo	19	5 p. m				Thunderstorm and hail.	About 600 window panes broken by hail, mostly in greenhouses, but plant damage slight.
Washington County, Okla	19	5:15 p. m	50–100	0	4,500	Tornado	1 injury. Several funnel clouds observed in various parts of county, but no damage other than near Dewey where 3 farm sections affected.
Hitchcock County, Nebr	19	7–7:20 p. m	[1] 2–6	------	805,000	Hail	Losses to wheat and alfalfa, $800,000; to buildings, $5,000. Path 15 miles long.
Mahoning County, Ohio	19	Evening				Wind	In Youngstown a few buildings, mostly garages, damaged or unroofed; a number of windows broken; a good many trees broken or uprooted; damage in a cemetery estimated at $5,000.
Hereford, Deaf Smith County, Tex.	19				200,000	Hail	Damage to wheat and potatoes.
Sheridan Field (8 miles east of), Wyo.	20	Afternoon				do	Light damage to alfalfa.
Wray, Colo	20	12:45–2:30 p. m	440	0	200,000	Tornado, hail, and rain.	Forming at Beecher Island, about 8 miles south of Wray, tornado struck first at various points eastward, and moving over Colorado-Nebraska line, destroyed many farm buildings in its path. Some hail accompanied storm, but practically all damage from tornado.
Haigler (near), Dundy County, Nebr.	20	2–2:25 p. m		0	13,100	Tornado	Moved northeastward, skipped a considerable stretch but swooped down on 2 farms, demolishing buildings; small amount of livestock lost. 1 personal injury.
Mound City, Ill	20	2:30 p. m			100,000	Wind and hail	Storm covered 40-square-mile area, most damage caused by wind. 1 new building demolished and many other structures damaged. Considerable strawberries and tree fruits destroyed. A few persons slightly injured.
Scott and Lane Counties, Kans.	20	4–6 p. m	200	0	200,000	Tornado and hail	Storm began 12 miles southwest of Scott City and ended 6 miles northeast of Healy, in Lane County. Tornado cloud observed. Hail in scattered portions of counties. Farm buildings and crops damaged over 25-mile path.
Sheridan County, Kans	20	4:30 p. m	[1] 3	------	70,000	Hail	Storm moved northeastward about 35 miles across central portion of county. Hailstones mostly ½ inch or less in diameter.
Rawlins, Decatur, Cheyenne, and Thomas Counties, Kans.	20	Late afternoon		0		Tornadoes	A number of small tornadoes at numerous points. Damage generally confined to farm buildings, fences, telephone, and power lines.
Balko and Beaver, Okla	20	5:10–5:20 p. m	100	1	1,500	do	6 distinct funnel clouds observed, but only 3 touched ground. Length of paths short, longest about 4 miles. Farmer killed near Balko.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Barren Creek Community and Goin Section, Tenn.	20	6 p. m.	1,500	0	37,500	Tornadic, wind and hail.	Storm traveled eastward for 5 miles. 3 persons injured. Hail, up to size of hens' eggs, and cloud burst destroyed new crops and washed away much topsoil in 2 communities. 5 houses and 2 barns blown away. Crop damage $25,000, included in total.
Ellis and Woodward Counties, Okla.	20	6–7 p. m.	100	0	400,000	Tornado, wind, and hail.	Damage estimated at $340,000 for tornado, $50,000 for hail, and $10,000 for high wind. 5 or 6 funnels observed in Ellis County. Tornado cloud touched ground at intervals. Funnel observed approaching airport near Gage from west, apparently from Shattuck but not seen touching ground; so, may have been high wind damage to aircraft and hangar at Gage. Accompanied by hail, $50,000 damage to crops in Ellis County; hailstones unusually large and jagged, some more than 3 inches in diameter at Woodward Field station. $250,000 damage to airport property west of Woodward. Considerable farm property destroyed. 3 injuries at Woodward air base. Path about 35 miles long; storm appeared to move northeastward then eastward then northeastward.
Ellis County, Kans.	20	6:30 p. m.			50,000	Hail	Hail of varying intensity fell in numerous places; most damaging in western portion. Wheat principal loss.
Gray, Ford, Hodgeman, and Pawnee Counties, Kans.	20	6:30–7 p. m.		0	510,000	Tornadoes, wind, and hail.	Numerous funnel-shaped clouds followed irregular courses along general storm path from Copeland, in Gray County, northeastward into western Pawnee County. Damage resulted as tornadoes dipped to earth occasionally near Copeland, Howell, Hanston, and Rozel. Several persons injured at Rozel. Much property damage and some wheat loss from hail. 4 funnels seen near Dodge City.
Russell County, Kans.	20	7–8 p. m.	[1] 1		90,000	Wind	Path of destruction from about 3 miles northwest of Gorham to 6 miles southeast. No well developed funnel observed. Debris indicated twisting winds. A school house partially destroyed; roofs, porches, and small buildings damaged. 24 freight cars blown from tracks.
Barton County, Kans.	20	7–8 p. m.	[1] 2		100,000	Hail and wind	Some roofs damaged, much glass broken, considerable wheat loss, and many power and telephone lines out. Several storm paths across county.
Comanche County, Kans.	20	7:30 p. m.	100	0	200,000	Tornado	Tornado cloud formed 7 miles southwest of Coldwater, passed about ¾ mile north of Coldwater to Wilmore, 12 miles northwest, where business and residential buildings damaged. Damage to crops, buildings, power and telephone lines, and trees all along path; especially severe at Wilmore.
Catesby (near), Ellis County, Okla.	20	7:30 p. m.	67	1	8,000	do	1 injury. Farmstead destroyed.
Lincoln County, Kans.	20	7:45 p. m.		0	8,000	do	Tornado struck a mile southeast of Lincoln, moving northeastward about 4 miles. Windmills and small buildings demolished; trees broken and uprooted. Distinct funnel-shaped cloud observed.
Saline and Dickinson Counties, Kans.	20	8–8:30 p. m.	440	1	50,000	Tornado and hail	Storm moved almost north from 7 miles southwest of Gypsum to a few miles northeast of Solomon. Railroad bridge near Gypsum partly torn up. Numerous farm buildings, and business and residential property in Solomon damaged. Crops in several scattered localities destroyed to great extent by hail. 5 persons injured. Some evidence of second tornado in vicinity.
Rice County, Kans.	20	8:40 p. m.	880	0		Tornado	Small tornado hit Chase, moving eastward along main street. A few houses and business buildings damaged. 1 person injured. Communication lines cut. Path extended about 1 mile.
Custer County, Okla.	20	8–9 p. m.	1,760	0	305,000	Tornado and hail	Damage estimated at $105,000 for tornado; $200,000 (60–85 percent wheat crop) damage by hail. Path east-northeastward 27 miles. 1 injured at Butler, and 2 injured at Thomas. 5 farm houses destroyed, many damaged; much barn damage in affected areas. 25 places damaged at Thomas. Cotton gin destroyed at Butler. At farm 4 miles west of Thomas, 13 cattle in feed lot lifted out of pen and came down unhurt ¼ mile away; 1 cow left in pen unhurt. Farmer 5 miles west of Thomas warned community.
Woodward County, Okla.	20	8:30 p. m.		0	14,000	Tornado	Several farmsteads damaged west of Vici. 4 homes unroofed at Moreland. Path from west of Vici through Booster station, 5 miles northeast of Moreland.
Hammon and vicinity, Custer County, Okla.	20	8:30 p. m.	1,760	0	17,000	Tornado and hail	Crop damage estimated at $10,000, property damage at $7,000; tornado damage estimated at $14,500, hail damage at $2,500. Path northeastward, 12 miles long.
Woods County, Okla.	20	9 p. m.	30–100	0	56,000	do	Northeast path about 12 miles long from 12 miles south of Waynoka to 12 miles east and 5 miles north. 3 sets of farm buildings completely blown away. Moderate hail preceded tornado; considerable damage by hail, but amount not estimated.
Sumner County, Kans.	20	9 p. m.		0		Tornado	Tornado hit 9 miles southwest of Wellington, damaging several farm homes and barns.
Alfalfa and Grant Counties, Okla.	20	9–9:30 p. m.	[1] 12	1	2,500,000	Tornadic and hail	1 death at Yewed. 2 injured at Nash; 25 injured in Alfalfa County. Appeared as if in high wind and hail area there may have been 1 or more tornadoes. Possibly a tornado at Nash, Grant County. Crop damage estimated at $1,000,000; buildings and other property damage at $1,500,000. Path from 1 mile north of Cherokee to Nash.
Rogers, Ark.	20	Evening				Wind	Damage to power and telephone lines.
Dickinson and Geary Counties, Kans.	20	9–9:30 p. m.		0		Tornado	Path of tornado extended from Hope, in south-central Dickinson County, to a few miles north of Junction City, just missing that city on the northwest. Power and communication lines torn down and numerous barns, sheds, and some houses destroyed.
Lyon and Wabaunsee Counties, Kans.	20	9:30–11:30 p. m.	300	0	75,000	do	Tornado began 5 miles northwest of Emporia and moved northnortheastward, ending 6 miles north and 5 miles east of Harveyville. Farm homes, barns, sheds, and telephone and power lines destroyed. 1 person injured. Entire path about 30 miles long. Peculiar roar of tornado heard by many, but no funnel-shaped cloud seen due to darkness.
Blaine and Kingfisher Counties, Okla.	20	10 p. m.	440–[1] 2	1	68,500	Tornado and wind	1 death at farm 16 miles southwest of Watonga; 7 injured. 30 farms suffered extensive damage in 55-mile path northeastward across Blaine County from west of Greenfield into Kingfisher County, with zig-zag path to Omega and Loyal; high wind at Dover. Crop damage to wheat estimated at $45,000. Damage in Blaine County, $27,000; damage in Kingfisher County, $41,500.
Blaine County, Okla.	20	Late evening		0	10,000	Tornado	5 farms badly damaged northwest of Watonga.
Blaine County, Okla.	20	do			20,000	Wind	High winds over much of county in addition to tornado damage areas. School at Greenfield unroofed; several other buildings damaged. Damage to ripening wheat.
Payne County, Okla.	20	Night		0	15,000	Tornado	Several farm homes severely damaged. Path northeastward for 18 miles from 8½ miles south of Stillwater to 4 miles east.
Pawnee County, Okla.	20	Night			275,000	Hail	In scattered sections of entire county.
Woodward (2¼ miles east of), Okla.	20		50–75	0	3,000	Tornado	Farm house destroyed.

See footnote at end of table.

SE RE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Allen County, Kans.	20-21	Midnight.				Wind	Store windows damaged; tree limbs and power lines broken. Damage mainly in Iola and La Harpe.
Jay County, Ind.	20		440	0	10,000	Tornado	East of Salamonia. Path 3 miles long.
Bristow, Creek County, Okla.	21	12:10 a. m.	300	0	15,000	Tornado and hail	Moved east-northeastward about 1½ miles.
Pawnee County, Okla.	21	Shortly after midnight.		0	60,000	Tornado	1 minor injury. Path northeastward from southwest of Cleveland to Cleveland, apparently divided at one point; part going southeast. Major damage to oil refinery and many homes.
Oologah, Rogers County, Okla.	21	12:30 a. m.	220	0	4,000	do	2 injured. About 7 miles to left of a tornado that occurred about 30 minutes later in same county.
Rogers and Craig Counties, Okla.	21	1:07-1:10 a. m.	100-200	0	30,000	do	5 tornadoes all moving northeastward as follows: 1. From 5 miles north of Claremore to Chelsea through Estella; northeastward for 18 miles. 2. White Oak, northeastward; path 3 miles. 3. South edge of Vinita; several residences damaged and part of roof blown off stockyards pavilion. 4. Definite track, parallel to No. 3, and 1 mile south. 5. At Big Cabin, damage to residences and roof on school gymnasium.
Mountain Grove (north of), Mo.	21	4:30 a. m.	880	1		Tornado and electrical.	Damage mostly to trees. 1 home, 2 barns, a garage, and a chicken house damaged. Boy killed by lightning at Cabool; probably not caused by this particular storm, but a part of same general storm condition.
Bentonville, Ark.	21	Morning				Wind	Considerable damage to automobiles, buildings, trees, and power lines.
Witt Springs, Estill County, Ky.	21	12:30-12:45 p. m.	150	0	10,014	Tornado	Length of path about 6 miles. 4 persons injured by falling building and other debris. 2 dwellings, 3 barns, and several out buildings damaged. Wires down in path of storm. Some baby chicks lost.
Audrain County (southern portion), Mo.	21	2 p. m.	880	0	1,000	Wind	Storm hit farming area 7 miles south and southwest of Mexico. Homes and buildings damaged on several farms. Some trees blown down and limbs of others broken. Small damage to wires.
Southern Pike and extreme northern Lincoln Counties, Mo.	21	3:30 p. m.	384	1	200,000	Tornado	A couple of small buildings on farm near Whiteside damaged. On many farms near communities of New Hartford, Ashley, Cyrene and Clarksville, Red Cross reported: 1 person killed, 20 injured; 14 homes destroyed, 9 damaged; 31 other buildings destroyed, 26 damaged. Only 5 percent of total damage was to crops and livestock. Storm dissipated into Mississippi River a short distance south of Clarksville.
Man and vicinity, W. Va.	21	3:30 p. m.				Wind, rain and hail.	4 persons injured and much property damaged. Roofs blown off several houses, grandstand, and store. Wooden cross on church snapped off and tops of trees twisted off; display signs blown down and plate glass windows blown in.
Pittsburg, Van Buren County, Iowa.	21	4 p. m.	440	0	30,000	Tornado	Path about ½ mile long in neighborhood of Pittsburg, a small community 3 miles northwest of Keosauqua. 8 houses damaged, plus several barns and smaller buildings. No personal injuries reported.
Reedy and vicinity, W. Va.	21	4:05-4:20 p. m.	440		7,000	Wind, hail, and rain.	Roofs blown off several buildings; windows broken in many homes; scores of trees blown down; 2 automobiles damaged by flying debris; power and telephone services temporarily disrupted. 1 home blown off its foundation; 3 horses killed by lightning; considerable damage to garden and farm crops.
Northeastern Franklin and northern St. Louis Counties, Mo.	21	4:30-4:50 p. m.	134	0	500,000	Tornado and hail.	Storm probably originated near Washington where it destroyed 4 barns and 21 other buildings and damaged 3 homes, 1 barn, and 11 other buildings. It then lifted, or dissipated and another one formed along the same path about 25 miles northeast, near Creve Coeur, where next reported, but no damage there. It then struck near southwestern edge of Lambert Field Airport, about 10 miles further to northeast; damage done to trees, buildings, and airplanes. However, it lifted and passed over the field without any further damage and did not dip to earth again until about 7½ miles northeast of airport, where most of damage occurred in Missouri, then continued to Wood River, Ill. In St. Louis County, Red Cross reported 2 persons injured, 2 homes destroyed and 11 damaged, 5 buildings of other types destroyed and 11 damaged. Damage to crops estimated at $75,000, mostly due to hail. Hail also damaged at least 75 automobiles to amount of about $9,400.
Mt. Sterling, Ill.	21	4:30 p. m.	200	0	40,000	Tornado	Storm first struck 4 miles southwest of Mt. Sterling and moved northeastward 12 miles through rural sections. 8 farm properties hit, with several barns destroyed or damaged, and several homes badly damaged. Crop and livestock loss negligible.
Wood River, Ill.	21	4:55 p. m.	800	5	1,300,000	do	Storm originated in Missouri northwest of St. Louis and struck Wood River after crossing Mississippi River. About 200 houses and 150 other buildings destroyed and several hundred structures suffered some damage. An oil refinery badly damaged. 2 trailer camps wiped out, about 25 trailers completely destroyed. 60 persons injured. In nearby rural areas several farms hit and 500 acres of timber destroyed. 50 head of livestock lost, but crop damage negligible.
Palestine, Ill.	21	5 p. m.	50	4	70,000	do	Struck west end of Palestine, demolishing restaurant, water pumping station, and 3 houses, and damaging about 20 other buildings. 7 persons injured. Most of dead and injured were in restaurant. Path northeastward into Indiana.
Chapmanville and vicinity, W. Va.	21	5 p. m.				Wind, hail, and rain.	Hailstones, disc shaped, up to 1¼ inches in diameter and ¼ inch thick; hail covered ground until white.
Sullivan and Clay Counties, Ind.	21	5 p. m.	150	14	1,000,000	Tornado	Moved into State from Palestine, Ill., through Shelburn, Clay City, Bowling Green, Poland and Lewis. Path northeastward. Complete destruction of houses in path of storm. $10,000 crop damage included in total. 251 persons injured.
Vigo County, Ind.	21	5:15 p. m.	200	3	500,000	do	Began in extreme east edge of city of Terre Haute, about 2½ miles east-southeast of Paul Cox Field, moved north-northeastward to just southwest of village of Burnett. 5 persons injured.
West Point, Lee County, Iowa.	21	5:30 p. m.				Wind	Severe local windstorm or possibly tornado struck 2 miles north of West Point, causing considerable damage on 5 farmsteads. No personal injuries.
Northern Bollinger and northwestern Cape Girardeau Counties, Mo.	21	5:45 p. m.-6:30 p. m.	220	1		Tornado	According to Red Cross reports, storm killed a man about 10 miles north of Marble Hill; injured 6 people; destroyed 7 homes, 7 barns, and 14 other types of buildings; and damaged 6 homes and 1 building. Little tillable land where tornado struck. No livestock losses.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Cape Girardeau County (southern part), Mo.	21	6:55–7 p. m.	200	23	4,000,000	Tornado	Most destructive in Missouri since the St. Louis tornado of September 27, 1927. Red Cross reported 130 injured, many seriously; 202 homes destroyed, and 231 others damaged, 19 places of business destroyed and 14 damaged, besides serious damage to church. Practically all damage occurred on west and especially north sides of Cape Girardeau along path about 10 miles long, traveling from about 3 miles southwest of city diagonally to northeast. Path clearly visible through forested area as seen across Mississippi River into Illinois, but no damage reported there.
Texarkana, Ark.	21, 23, and 24	7 p. m.				Hail and wind	Wind 50 m. p. h. caused minor damage to signs, roofs, and trees.
Marked Tree, Ark.	21	9:30 p. m.	400	0	3,000	Tornado and hail	Small tornado unroofed cotton house gin. Several houses damaged and trees uprooted.
Bradford, Ark.	21	Evening				Wind and hail	Trees blown across highway; slight property damage.
Mt. View, Ark.	21					Electrical and wind	
Red Boiling Springs, Macon County, Tenn.	22	2 a. m.		0	300,000	Tornado	Only slight crop damage. Many livestock killed or injured. Houses unroofed and wrecked, barns flattened, and many trees uprooted.
Somerset, Pulaski County, Ky.	22	2–2:05 a. m.	440	1	750,000	do	High winds lasted for about an hour. Several dwellings badly damaged; a large tobacco warehouse and wholesale grocery store completely destroyed. 2 large garages damaged. Little damage to livestock or crops.
Irvine, Estill County, Ky.	22	3 a. m.				Wind	Grandstand unroofed at ball park. Trees blown down. Total damages will run into many thousands of dollars.
Ripley and vicinity, W. Va.	22	2–2:20 p. m.	[1] 2	0		Near tornadic, hail, and rain.	Hailstones ¾ inch to 1½ inches in diameter. Neon signs, window panes, roofs, garden and farm crops damaged.
Bluefield and vicinity, W. Va.	22	2:05–2:16 p. m.				Hail	Hailstones from size of marbles to 1½ inches in diameter. Considerable damage to roofs, windows, signs, automobiles, gardens, and trees; telephone communications disrupted.
Glenville and vicinity, W. Va	22	2:25 p. m.	[1] 2		8,000	do	Considerable damage to crops, roofs, and windows.
Charleston, W. Va.	22	2:45–3:10 p. m.			100,000	Wind and hail	37 business buildings damaged, with some roofs blown off and numerous plate glass windows smashed. Power and telephone services disrupted.
Buckhannon and vicinity, W. Va.	22	3–4 p. m.				Hail	Hail, mostly small, some as large as walnuts. Some damage to roofs and gardens.
Berlin and vicinity, W. Va.	22	3:30–3:50 p. m.				do	Hailstones reported up to 6 inches in circumference.
Beaver and Butler Counties, Pa.	22	3:30–4 p. m.	440		58,300	Wind, hail, and rain.	Path southeastward for 20 miles from New Brighton to Harmony Junction, Jackson Township. Slight damage to crops. Most damage to property from wind in area from Zelienople to Harmony Junction. Damage to electrical and telephone installations estimated at $8,000, and $300 loss of cow, included in total.
Bayard, W. Va.	22	4 p. m.			10,000	Wind and hail	Hail, size of walnuts, at one time 3 inches deep. 200 house roofs severely damaged; trees badly damaged; birds killed and nests destroyed. Said to be worst hailstorm in history of Bayard.
Hastings (near), Adams County, Nebr.	22	4–4:30 p. m.	[1] 2			Hail	About 15 percent damage to alfalfa and wheat. Path 15 miles long.
Highland County, Va.	22	4–7 p. m.				do	3 hailstorms damaged crops, roofs, and broke a few windows.
Mount Clare and vicinity, W. Va.	22	Afternoon				do	Some damage to gardens.
Rohrbough and vicinity, W. Va.	22	do				do	Considerable damage to gardens.
Hornor and vicinity, W. Va.	22	do				do	Some damage to gardens.
Rotan, Fisher County, Tex.	22	5 p. m.	[1] 6			Wind and hail	Most of damage to trees, shrubbery, and roofs. About 50 percent loss to fruit trees.
Beaver County, Okla.	22	5:40 p. m.			76,000	Hail	Area 20 by 30 miles from Forgan to west, and east around Beaver. Heavy damage to crops south of Beaver. About $1,000 damage to windows and roofs.
Follett, Lipscomb County, Tex.	22	6 p. m.	[1] 3		1,200,000	Wind and hail	Crops in center of path total loss; no material loss to buildings. Hail damage estimated at $1,080,000. Storm started just south of Beaver, Okla., and moved southeastward. Wind damage, $120,000.
Lynchburg, Va.	22	6–6:30 p. m.				Hail and electrical	Hail up to size of billiard balls cut telephone and power lines. Lightning fired 3 houses.
Abilene, Tex.	22	7 p. m.	440		60,000	Wind and hail	Hail damage estimated at $30,000 $25,000 to crops and $5,000 to buildings. Wind damage, $30,000, mostly to buildings. Hail as large as baseballs, but very scattered, reported at Clyde. Holes in 1 roof looked like sledge hammer holes. 3 persons injured.
Cauthornville, Va.	22	8–8:30 p. m.	440	0		Tornado	Barn demolished, several buildings damaged, trees twisted off, crops destroyed over area ¼ by 1½ miles.
Baltimore, Md.	22	P. m.				Cloudburst and electrical.	Trees blown down. Busses and cars stalled due to heavy rains. Power failure caused by lightning and by trees blown across wires.
Allegany, Harford, and Montgomery Counties, Md.	22	P. m.				Hail and rain	Heavy hail in Allegany and Montgomery Counties and some hail in Harford County. Some crop damage over State.
Aberdeen, W. Va.	22	Evening				Hail	Hailstones up to 2 inches in diameter. Extreme damage to crops.
Rhode Island, southern portion.	22	Night				Electrical and rain	6 persons injured by lightning; 2 houses struck and damaged. Streets in Providence flooded to depth of 6 to 8 inches. Power interrupted briefly in Westerly, Bristol, and Cranston.
Rogersville, Hawkins County, Tenn.	22					Hail and wind	Considerable damage to crops.
Maynardville, Union County, Tenn.	22					Hail, wind, and rain (tornadic character).	Considerable damage to crops. Considerable erosion. Trees uprooted, several roofs destroyed or damaged.
Southern Garden County and northern Deuel County, Nebr.	22		[1] 3–6		512,725	Hail and wind	Crops totally destroyed in places, damage estimated at $512,000; to livestock $225; to buildings $500. Path 30 miles long.
Fillmore, Lee County, Ky.	22					Wind and rain	Church lifted from foundation, store unroofed, farm buildings and crops damaged.
Pebworth, Owsley County, Ky.	22					do	House torn from foundation; fences, trees, and other property scattered over countryside. Crops damaged.
Richmond, Madison County, Ky.	22					do	Radio tower at State Police station damaged.
Kenton County, Ky.	22					Wind	Huge tree fell on 4 parked automobiles. No personal injuries.
Mahoning, Stark, and Columbiana Counties, Ohio.	22					Rain and wind	Thousands of dollars damage caused by flooding of streets and basements and collapse of front wall of 3-story apartment house; many trees uprooted.
Eastern Audrain and southwestern Scotland Counties, Mo.	23	2:15 p. m.				Electrical and hail	Lightning struck several local transformers in Martinsburg, disrupting electrical service. Hail damaged gardens and crops north of Martinsburg near Laddonia, and gardens and some window lights near Bible Grove.

See footnotes at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Union Springs, Ala.	23	3:45–4:20 p. m.	[1]3			Hail	Fall not heavy, but falling stones ranged in size up to hens' eggs, and continued for considerable length of time. Some crop damage; a few windows broken.
Lincoln and Chandler Counties, Okla.	23	4 p. m.	1,320		50,000	do	Path 10 miles long from 4 miles west of Chandler to 6 miles east. Most of damage to crops; some window and roof damage.
Perkins County (western part), Nebr.	23	5 p. m.			811,000	do	Crops completely destroyed in places; damage estimated at $800,000, crops in storage $1,000. Roofs badly damaged; many windows broken; property damage estimated at $10,000.
Beaver County, Okla.	23	6:15 p. m.			75,000	do	Duration of storm about 40 minutes. Heavy hail east of Beaver and Knowles. Area 20 by 30 miles. Some land covered with 3 inches of hail.
Greeley, Wichita, Kearney, Finney, Haskell, Gray, and Ford Counties, Kans.	23	Afternoon		0	2,500,000	Hail and tornadoes	A combination of approximately 25 separate hailstorms spread from just east of Tribune southeastward to southern Ford County. Finney County suffered greatest damage. Hail varied greatly in intensity and ranged in size from peas to golf balls. Much wheat ruined; considerable glass broken, and roofs and cars damaged. 2 small funnel-shaped clouds observed south of Garden City but caused no damage.
Kingfisher County, Okla.	23	7 p. m.	200–250	0	105,200	Tornado and hail	Path 8 miles long from northwest of Hennessey, through Hennessey southeastward. $72,000 hail and wind damage to crops. $24,000 tornado damage to buildings, $9,200 damage to livestock and crops in storage.
Ponca City (western portion), Okla.	23	8 p. m.			25,000	Hail and wind	Damage to roofs and windows of buildings, and car top
Logan County, Okla.	23	8 p. m.			50,000	do	Crop damage, $40,000. Many windows broken and several buildings damaged in Crescent.
Barry County (southern part), Mo.	23	8 p. m.	[1]5			Electrical	Barn struck by lightning and burned. Man also struck; recovered later. Storm centered in 5-mile area about 7 miles northeast of Seligman.
Montgomery, Ala.	23	9:25 p. m.			2,000	Thundersquall	Roof and porch damage to veterans' housing project.
Hughes County, Okla.	23	10 p. m.			20,000	Hail and wind	Most of damage by hail in area north of Holdenville, estimated $19,000. Some damage to trees and buildings in Holdenville.
Garfield County, Okla.	23	Evening			10,000	Hail	Crop damage severe west of Waukomis.
Wilburton, Okla.	23	do		0	500	Tornado	Storm moved northeastward, causing some damage to buildings along west end of Main Street and in northeastern section.
Comanche County, Kans.	23	do	[1]2		35,000	Hail	Storm occurred in southwestern portion of county, causing 100 per cent loss to some wheat fields in path 3 miles long.
Pawnee County, Kans.	23	Night			6,000	do	Several storms in northern and western parts of county. Most damage in area near Rozel and Garfield.
Phillips, Wyo.	23					do	Light damage to alfalfa and winter wheat.
Southampton County, Va.	24	2:30–3:15 p. m.			26,000	Hail and rain	Heavy damage to crops by hail and erosion in Capron, Joyner, Sebrell and Triangle areas. Some windows broken and roofs damaged.
Elkins, W. Va.	24	3:30 p. m.				Electrical	Lightning struck building at airport. Principal damage to CAA communication equipment, lesser damage to Weather Bureau equipment.
Ford County, Kans.	24	4 p. m.	[1]6		500,000	Hail	Damage extended over strip 20 miles long from northwest of Dodge City to Bloom. Many stones 2 inches in diameter.
Richmond, Va.	24	7 p. m.				Electrical	Large barn with hay burned.
Refugio, Refugio County, Tex.	24	7 p. m.	[1]4		37,000	Wind and hail	Hail damage estimated at $12,000. Home gardens beaten down; no farms within area. Several garages blown apart and roofs from several small houses blown away. Some small homes blown off foundations. Many trees broken and uprooted. Window panes broken. 1 person injured.
Anne Arundel County, Md.	24	p. m.				Wind, rain and thunderstorm.	Wind capsized small boat at pier in Round Bay on Severn River. Tree branches blown across roads and telephone wires.
Pittsfield, Mass.	24	Night				Electrical	1 house struck and destroyed by fire. Damage to power and transmission lines.
Knox County (northern part), Mo.	25	3–5 p. m.	[1]8		3,000	Hail	Storm struck at Greensburg damaging gardens, truck patches, and breaking a few window lights. Hailstones ranged from ½ to 1½ inches in diameter. $3,000 crop damage included in total.
Madison (near), Morgan County, Ga.	25	4 p. m.				do	Area 6 x 8 miles southwest of Madison affected, within which very heavy damages over area 3 x 3 miles, where reports indicate crops completely destroyed. Cotton and corn chief crops affected, with losses likely to exceed $10,000. Little or no damage to property.
Linn County (southwestern part), Mo.	25	4:50–5:20 p. m.	[1]1			do	Hailstones from size of hulled walnuts to hens' eggs did much damage to gardens, crops, and some roofs at Laclede, Linneus, Pershing Park area, and in spotted areas nearby, and also near Brookfield.
Cooper County (southwestern part), Mo.	25	8–8:30 p. m.	440			Wind and hail	Some building roofs damaged and some windows broken by the storm which struck Clifton City. Largest hailstones said to be the size of ping-pong balls.
Morgan County (western part), Mo.	25	8:30–9 p. m.	[1]1½		8,000	Hail	Territory covered by hailstorm included Stover and to southwest of town; appeared to be spotty. Stones varied from about ⅝ inch to some reported as large as hens' eggs. Crop damage estimated at $5,000 included in total. Most other damage to roofs.
Cowley County, Kans.	25	Night			250,000	Hail and wind	Principal damage to wheat in southern portion of county, where approximately 10,000 acres destroyed.
Moore, Lee, Wayne, Columbus, Johnston, Bladen, Onslow, Duplin, and Robeson, N. C.	26	Noon				do	Same thunderstorm that produced tornado. Heavy crop damage in some areas.
Sampson, Johnston and Wayne Counties, N. C.	26	12:30 p. m.	200–300	0	100,000	Tornado	First struck 8 miles east of Dunn. Path due east to 2½ miles west of Newton Grove, passed ¾ mile north of Newton Grove to 2¾ miles east of Newton Grove. Path 12 miles long. Storm dipped to earth at intervals. Funnel cloud believed to have split into 2 funnels north of Newton Grove, then rejoined soon after. A heavy hailstorm, with hail as large as golf balls, occurred late in morning at Dunn. After hailstorm a large rolling scud cloud with thunderhead cloud observed. This may be taken as evidence of severe turbulence present in area preceding formation of tornado. A few minor injuries.
Lake City, Ark.	26	3 p. m.				Hail	Some damage to crops and gardens.
Greensville County, Va.	26	6–6:25 p. m.				do	Hail killed some poultry; corn and cotton had to be replanted in small area near Emporia.
Haskell and Seward Counties, Kans.	26	6 p. m.	[1]8		125,000	Hail and wind	Damage strip extended from 5 miles south of Sublette to 5 miles south of Liberal in north-and-south line of 25 miles. Most damage in Seward County. Hail generally size of marbles.
Grant County, Kans.	26	Afternoon	[1]2–5			Hail	Path of destruction extended from north-central part of county to southeast corner, almost 25 miles.
Northeastern Webster and northwestern Wright Counties, Mo.	26	10–11 p. m.	[1]1½		1,150	do	Area covered some 35 to 40 farm homes; many buildings suffered roof damage with some damage to automobiles. Stones varied from 1½ inches to oblong shape 2 inches long and 1 inch wide.

See footnote at end of table.

SEVERE STORMS FOR MAY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Bourbon County, Kans.	26	Evening	[1] 2		500	Hail	Storm moved eastward along a path of 5 miles in western part of county.
Dundy County (northeastern part), Nebr.	26		[1] 6		200,000	do	Losses to wheat crop. Path 20 miles long.
Green Forest, Ark.	27	11 a. m.				do	Considerable damage to crops and fruit over small area.
Madison, Ark.	27	Evening				do	Damaged crops and gardens.
Big Flat, Ark.	27	do				do	Considerable damage to gardens and crops.
Pryor (4 miles south), Okla.	28	Noon		1		Electrical	One vivid streak of lightning struck and killed boy.
Blaine County, Okla.	28	1 p. m.			75,000	Hail	Area 3 x 5 miles, 6 miles west of Watonga; destroyed nearly ripened wheat.
Geyser, Mont.	28	2:30 p. m.				do	Some damage to alfalfa.
Isle of Wight County, Va.	28	6–6:15 p. m.			500	do	All crops had to be replanted over area ½ x ¾ mile.
Raleigh, Grant County, N. Dak.	28	Evening	[1] 5		150,000	do	Most damage in strip about 5 miles wide and 8 miles long, approximately 5 miles south of Raleigh. Hail covered ground several inches thick, broke many windows, some crops complete loss.
Hobson and Windham, Mont.	28–29					do	Light damage to alfalfa. Hail 4 to 8 inches deep on level.
Thief River Falls and vicinity, Minn.	29	A. m. and p. m.			361,200	Rain	Excessively heavy rains, accompanying severe thunderstorms, flooded fields, lowlands, highways, roads, streets and basements. Some homes, buildings, and merchandise stored in basements damaged; much poultry perished; much washing, drowning of growing crops and some fields of small grain reported total loss. Rivers and creeks overflowed and some bridges washed out.
Gooding, Jerome, Lincoln and Blaine Counties, Idaho.	29	12:30–7 p. m.			15,000	Hail and wind	Evidently a series of thunderstorms moving generally northeastward. Principal damage in and near Gooding where all small crops such as beet, beans, corn and alfalfa about 75 percent destroyed, mostly by hailstones ⅝ to 1¼ inches in diameter; green house at least 50 percent destroyed. Hail caused about $5,000 damage to grain in early head near Shoshone and $7,000 damage to alfalfa near Hailey where numerous trees blown down and estimated $500 damage to property occurred. About 40 percent damage to hay occurred on ranch near Jerome.
Deer Lodge, Mont.	29	3 p. m.	8			Hail	Hail lasting about 10 minutes damaged alfalfa and small grains over 30 mile path.
Judith Basin and Fergus Counties, Mont.	29	3 p. m.	3			do	Hail size of peas to walnuts did considerable damage to wheat and barley. Path 7 miles long.
Danvers, Mont.	29	3:30–4 p. m.	2			do	Hail, size of peas, damaged wheat in 15 mile path.
Wolf Creek, Mont.	29	5:30 p. m.	2		9,000	do	100 acres of alfalfa destroyed; considerable damage to gardens and early crops. $5,000 damage to roofs and electric signs.
Maine, southwestern portion.	29	Evening				Electrical	1 house in New Castle struck and completely destoyed by fire. Several other houses struck with minor damage. Hail at several points in Cumberland and Androscoggin Counties. An estimated depth of 1 inch reported at South Paris; largest stones about the size of "good-sized peas." No hail damage recorded.
Cascade, Mont.	29					Hail	Hail up to 8 inches in diamater did moderate damage to gardens, small grains and hay.
Thomas County, Kans.	29–30	Midnight–1 a.m.	[1] 2		500,000	do	Storm began a mile east of Colby, traveling southeastward 15 miles to near county line. Hailstones up to 1 inch in diameter. Wheat main loss.
Forest, Miss.	30	5 p. m.				Wind	Damage small, mostly to trees and corn.
Yazoo City, Miss.	30	Late afternoon				do	Do.
Mobile, Ala.	30	8:30 p. m.	100		6,000	Thundersquall	Damage to boat house and machine shop.
Anceney (near), Mont.	30	P. m.	1½		10,000	Hail	Heavy hail ½ inch in diameter caused considerable damage to winter wheat and spring grains over path 5 miles long.
Craig (near), Mont.	30	Evening				Hail and rain	Flooding of about 4 miles of highway interrupted travel on U. S. Highway 91 for over 2 hours.
Cooper County (southwestern part), Mo.	31	1:15–1:35 p. m.	440			Wind	Wind from southwest blew over some large trees and small buildings, and moved others off foundations in Clifton City.
Canal Point, Fla.	31	3–4 p. m.				Wind and muck dust.	Clouds of powdered brown muck reduced visibility to near zero for an hour.
Blakely (near), Early County, Ga.	31	3:30 p. m.			2,500	Wind and hail	Storm struck local airport on outskirts of Blakely. 1 airplane demolished; wind damage to hangar roofs. Moderate to heavy hail, ¼ to ½ inch in diameter, beat down cotton and peanuts but losses not more than about $500.
Riley County, Kans.	31	6:20 p. m.	134	0	15,000	Tornado	Funnel first sighted about 8 miles west of Manhattan and ended 5 miles north of Manhattan. Tornado dipped only once, unroofing a farm home and destroying other farm buildings and machinery. Power and telephone lines also damaged.
Miami International Airport, Fla.	31	8 p. m.				Thunderstorm, wind and hail.	Strong, gusty winds skidded parked airplanes into a pile up. Winds from south-southwest. Area of damage very limited in front (west) of row of hangars in north to south line. No evidence of twisting winds found. Possibly gusts were increased by alignment of hangars. Highest winds at the Weather Bureau Airport office, 1 mile north of damaged area, were south-southwest 38 plus with gusts to 50 m. p. h.
Jackson, Greer, and Kiowa Counties, Okla.	31	9 p. m.	100		2,500,000	Hail and wind	Mostly hail damage to nearly ripened wheat in scattered areas throughout Jackson and Greer Counties, but most damage in Kiowa County where crops destroyed in 100 square mile area from Lone Wolf to Gotebo.
Moorhead and vicinity Minn.	31	9–10 p. m.			30,700	Thundersqualls	4 greenhouses demolished; warehouse partially unroofed; football field press box wrecked; buildings, houses, garages, sheds, barns and farm outbuildings damaged; awnings, canopies, signs and billboards blown away; many windows broken; automobiles damaged; power and communication lines down; many trees uprooted or branches broken off; slight damage to growing crops.
Ashley, McIntosh County, N. Dak.	31	10 p. m.			50,000	Wind	Small buildings in town and on farms blown over; some larger buildings damaged. Few trees blown over.
West Fargo, N. Dak.	31	10 p. m.		0	10,000	Wind possibly tornado.	Stock shed of Armour & Co. completely demolished. Other buildings nearby not damaged; this leads to belief that it was tornado of smalll proportions.
Johnson County, Kans.	31	11:20 p. m.	440	0	15,000	Tornado and wind	Funnel first dipped to earth in southwest corner of Gardner, damaging houses and trees for about 4 blocks; traveled northeastward. It skipped to Olathe, where some damage done at Naval Air Station and windows and light wire broken in Olathe. High winds in other parts of county resulted in some property damage.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR MAY 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, volume 72, No. 1, January 1944, page 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in volume 75, No. 3, March 1947, page 47.

Beginning with this issue values of total solar and sky radiation received on a horizontal surface at Seabrook, N. J., will be included regularly in table 2. The new station located at Seabrook Farms, Seabrook, N. J., is sponsored by Dr. C. W. Thornthwaite, director of the Johns Hopkins Climatological Laboratory, and the equipment and record will be maintained by Mr. D. J. Portman, meteorologist at the Laboratory. A Brown Electronik strip recorder has been installed. The coordinates of the station are: Latitude 39°30′ N., longtitude 75°14′ W., elevation 34 meters, m. s. l. Obstructions: Two small ventilators to the northeast and southwest, neither of which will cause more than slight shading at certain seasons of the year; a 250-foot smokestack 400 yards to the southeast whose shading is inappreciable, but which creates some smoke pollution of the atmosphere for brief periods.

TABLE 1.—*Solar radiation during May 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
May	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
2						1.14	0.96			8.4	7.8
3	0.66	0.77	0.88	1.02	1.30	.98	.70			10.2	14.8
5	.33		.57	.69	.98					19.6	21.1
6	.47	.60	.77	.87						17.0	16.5
7	.69	.76	1.01	1.18						9.1	8.1
10	.68	.76	.88	1.06	1.28	.96				5.1	6.1
11	.39	.43								4.8	8.7
12				.62	1.11					10.2	9.4
13	.30	.36	.49	.71	1.06					11.4	14.2
24		.76	.95	1.13	1.38					7.2	3.7
26	.68	.77	.94	1.14	1.37	1.07				9.1	6.6
28	.75	.87	.96	1.18	1.29					7.8	7.4
Means	.55	.68	.83	.96	1.22	1.04	.83				
Departures	−.07	−.10	−.11	−.10	−.14	−.01	−.05				

TABLE 1.—*Solar radiation during May 1949*—Continued

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
May	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1					1.51						
4				1.37							
6	1.01	1.13	1.24	1.38	1.58						
10				1.35							
13				1.34							
21	1.09	1.19	1.29	1.42	1.56						
Means	1.05	1.16	1.26	1.37	1.55						
Departures	−.02	−.01	.02	−.01	+.03						
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
May	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1				0.80						11.3	13.9
4	0.75	0.85	0.99	1.14						9.5	9.2
8	.80	.90	1.05	1.23	1.39	1.00	0.84	0.67	0.57	6.5	6.5
14		.49	.63	.77						9.2	12.7
15					1.42					8.4	8.7
16				1.00		.71	.51	.39	.28	9.4	11.5
17			.57	.69		.43	.31	.21	.18	11.9	11.0
18				.70						16.8	16.9
21					1.49	1.21	1.02	.86	.74	9.6	8.6
25					1.48					14.7	7.6
26	.85	.94		1.30						6.6	9.3
29							1.00	.84		8.7	7.9
30	.88	.98	1.07							8.7	7.5
31	.79	.91	1.04	1.20						9.2	8.5
Means	.81	.84	.89	.97	1.44	.84	.74	.59	.44		
Departures	+.14	+.04	−.06	−.12	+.07	−.22	−.14	−.14	−.19		
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
May	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
2					1.35	1.08	0.86	0.75	0.64	7.4	12.3
12					1.21	.97	.82	.69	.60	14.2	15.3
24					1.40	1.12	.92	.82	.71	8.1	7.8
25					1.31	1.08				12.3	16.4
26					1.32	1.08				11.4	13.2
Means					1.32	1.07	.87	.75	.65		
Departures					−.05	−.05	−.03	−.05	−.02		

[1] 75th Meridian Time.
*Extrapolated.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface during May 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Inyokern, Calif.	Oak Ridge, Tenn.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Seabrook, N. J.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	East Lansing, Mich.	Madison, Wis.	Toronto, Canada	Summit, Mont.	Fairbanks, Alaska
1949	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
April 30	470	457	549	670	701	147	115	627	632	456	392	657	630	588	586	534	593	382	644	469	589	644	578	384	597	357	529	526	300	609
May 1	578	483	555	679	718	219	106	723	601	207	492	646	305	408	260	534	137	347	545	430	606	635	576	177	289	223	178	306	378	600
May 2	580	405	266	------	740	240	604	739	360	129	667	496	283	751	327	681	360	646	463	652	492	373	316	260	622	575	676	442	147	338
May 3	706	638	368	------	728	610	695	695	646	610	------	752	500	601	452	578	677	601	206	683	163	206	164	402	403	274	665	597	(334)	503
May 4	700	497	608	576	731	689	694	759	640	610	------	777	644	532	557	336	622	438	631	595	587	639	549	383	655	460	499	498	476	446
May 5	790	708	616	625	750	650	658	731	701	600	------	(824)	617	229	495	338	469	390	608	631	578	612	527	301	622	444	615	331	657	658
May 6	750	672	636	652	761	577	646	738	712	542	------	(809)	548	453	373	533	591	162	340	624	377	334	281	389	660	515	353	486	710	640
Means	653	552	514	640	733	447	502	716	621	451	------	708	504	509	436	505	493	424	491	583	485	492	427	328	550	450	502	455	429	542
Departure	+1	−16	−46	+84	------	------	+41	+84	−11	−16	------	+60	------	−6	+7	−4	+65	−23	+23	+133	+40	+33	+40	−58	+10	+97	+59	−11	−77	+103
May 7	723	675	588	583	667	508	634	634	641	422	------	597	442	395	535	637	601	275	407	448	328	376	318	225	656	440	684	631	686	660
May 8	790	690	528	651	735	671	528	756	439	612	------	418	722	426	683	704	690	48	742	671	684	730	727	449	661	(463)	424	563	704	548
May 9	779	568	470	558	754	437	471	728	603	486	------	584	596	711	556	394	724	508	720	280	658	662	562	320	329	(126)	393	443	654	458
May 10	796	717	615	600	740	488	252	722	675	90	------	479	72	625	150	626	518	632	127	719	116	325	304	432	529	608	706	649	541	535
May 11	724	641	403	590	697	496	744	706	683	108	------	775	120	331	330	190	278	498	463	756	276	563	577	475	525	512	416	664	(711)	518
May 12	788	694	209	504	685	627	691	694	610	679	------	294	742	556	682	490	716	645	130	667	159	114	65	447	618	448	641	500	708	542
May 13	522	380	120	273	698	664	641	686	663	559	------	(526)	621	254	577	675	410	516	648	634	618	669	563	430	502	508	541	545	531	355
Means	732	624	419	537	711	556	566	704	616	422	------	524	474	471	502	531	562	446	463	596	406	491	445	397	546	444	544	571	648	517
Departures	+53	+35	−132	−10	------	------	+77	+54	−45	−56	------	−16	------	−13	+58	+40	+114	−4	−11	+158	−52	+24	+39	−12	−2	+62	+89	+42	+116	+64
May 14	676	573	332	214	482	621	640	155	377	505	------	350	598	690	488	402	313	490	606	532	602	586	497	98	257	472	567	481	578	493
May 15	578	621	324	150	------	637	651	355	390	406	------	245	428	495	500	366	466	296	641	474	634	677	664	438	529	243	274	590	573	586
May 16	548	450	166	162	------	586	458	295	666	214	------	389	485	471	558	374	376	343	669	557	502	592	546	217	406	405	394	544	291	353
May 17	631	446	167	91	256	639	686	509	714	334	------	435	493	344	486	257	476	438	649	618	590	623	538	441	674	356	487	534	190	320
May 18	748	708	474	226	706	701	644	445	451	554	------	246	514	453	538	495	628	390	465	569	520	627	564	299	358	368	430	446	(416)	555
May 19	455	519	475	208	632	662	676	520	210	547	------	(320)	604	676	434	635	445	182	600	376	544	579	542	225	389	92	112	386	302	640
May 20	562	577	659	560	777	537	446	727	658	413	494	132	314	282	43	253	192	185	49	487	66	46	60	165	514	583	330	642	460	460
Means	600	556	371	230	571	626	600	430	495	425	------	302	491	487	448	397	414	332	526	516	494	533	488	269	447	360	371	518	401	487
Departures	−34	+2	−164	−289	------	------	+124	−212	−120	−44	------	−182	------	−14	00	−96	+4	−174	+45	+110	+56	+57	+115	−129	−143	+18	−96	+12	−84	+22
May 21	734	632	675	662	760	524	556	779	724	340	554	(806)	721	366	683	614	344	188	778	581	738	787	735	484	718	362	160	557	172	418
May 22	763	636	644	664	755	302	656	782	685	316	608	809	233	440	62	630	281	522	156	370	249	222	159	91	614	107	491	161	125	109
May 23	568	514	621	666	752	532	482	779	748	602	619	818	513	480	454	740	546	480	575	656	544	478	430	252	702	477	317	490	(425)	411
May 24	506	346	644	628	702	278	200	778	745	632	767	808	641	549	367	733	313	715	622	305	684	608	487	255	719	416	759	319	574	540
May 25	760	424	540	588	760	749	761	762	739	746	642	818	770	811	750	733	802	681	578	550	575	606	515	352	717	223	337	501	733	187
May 26	558	516	420	535	733	541	686	786	725	293	538	815	264	823	214	649	261	693	553	670	581	623	555	121	380	500	773	443	737	336
May 27	353	280	407	467	740	599	388	730	686	611	524	772	643	440	666	433	498	622	97	365	108	37	32	204	446	263	660	340	670	------
Means	606	478	564	602	743	504	533	771	722	506	607	806	541	558	456	647	435	557	481	499	497	480	416	251	614	336	500	416	491	334
Departures	+11	−32	+57	+56	------	------	+16	+105	+77	+8	+61	+178	------	+15	−2	+86	−37	+16	+33	−6	+29	+26	+8	−189	+14	−50	+3	−71	+55	−108
May 28	373	271	446	476	520	707	725	714	652	682	425	718	629	495	424	577	495	598	444	607	383	409	332	396	299	604	755	358	448	647
May 29	612	556	654	510	775	635	591	746	566	724	564	(293)	701	704	458	741	547	261	568	756	524	540	555	262	528	597	732	603	(250)	703
May 30	550	447	668	618	781	142	294	707	692	731	698	273	727	690	589	598	768	486	532	684	519	503	465	430	333	464	712	579	362	715
May 31	498	518	625	585	788	547	506	777	658	625	636	432	696	601	526	259	693	432	713	695	710	709	660	474	268	560	617	702	297	658
June 1	652	627	698	669	798	662	546	804	778	651	------	836	514	429	605	605	758	352	629	690	618	712	696	498	762	526	483	719	261	453
June 2	608	594	676	654	770	657	702	798	753	684	------	786	710	648	541	534	737	722	750	678	699	730	652	442	704	487	345	681	415	539
June 3	681	683	676	------	785	672	688	817	720	734	------	835	775	423	631	557	756	386	765	673	729	763	691	451	599	337	628	546	489	611
Means	568	528	635	585	745	575	579	766	688	692	------	596	679	570	529	553	679	462	629	696	598	624	579	422	499	511	610	598	360	618
Departures	−28	+7	+46	+55	------	------	+66	+94	+105	+174	------	−43	------	−35	+47	−39	+180	−58	+105	+128	+105	+102	+123	−44	−67	+81	+111	+67	−60	+119
ACCUMULATED DEPARTURES ON JUNE 3, 1949																														
	+77	+42	−5,768	−665	------	------	+3,360	+5,152	+1,134	−630	------	+413	------	------	------	−266	+4,165	−3,423	+1,526	+5,873	+308	+2,135	+2,709	−11,123	+980	+553	+3,115	+497	−14	------

NOTE.—Values in parentheses are interpolated.

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground as received on a vertical surface facing south at Blue Hill, Mass., during May 1949.*

Date	30	1	2	3	4	5	6	*Mean*	7	8	9	10	11	12	13	*Mean*	14	15	16	17	18	19	20	*Mean*
Gm cal/cm²	286	282	180	72	272	262	141	*214*	144	283	268	135	243	36	262	*196*	247	282	232	253	254	236	13	*217*
Date	21	22	23	24	25	26	27	*Mean*	28	29	30	31	1	2	3	*Mean*								
Gm cal/cm²	262	95	194	222	215	220	8	*174*	190	205	189	256	209	264	263	*234*								

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Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, May 1949

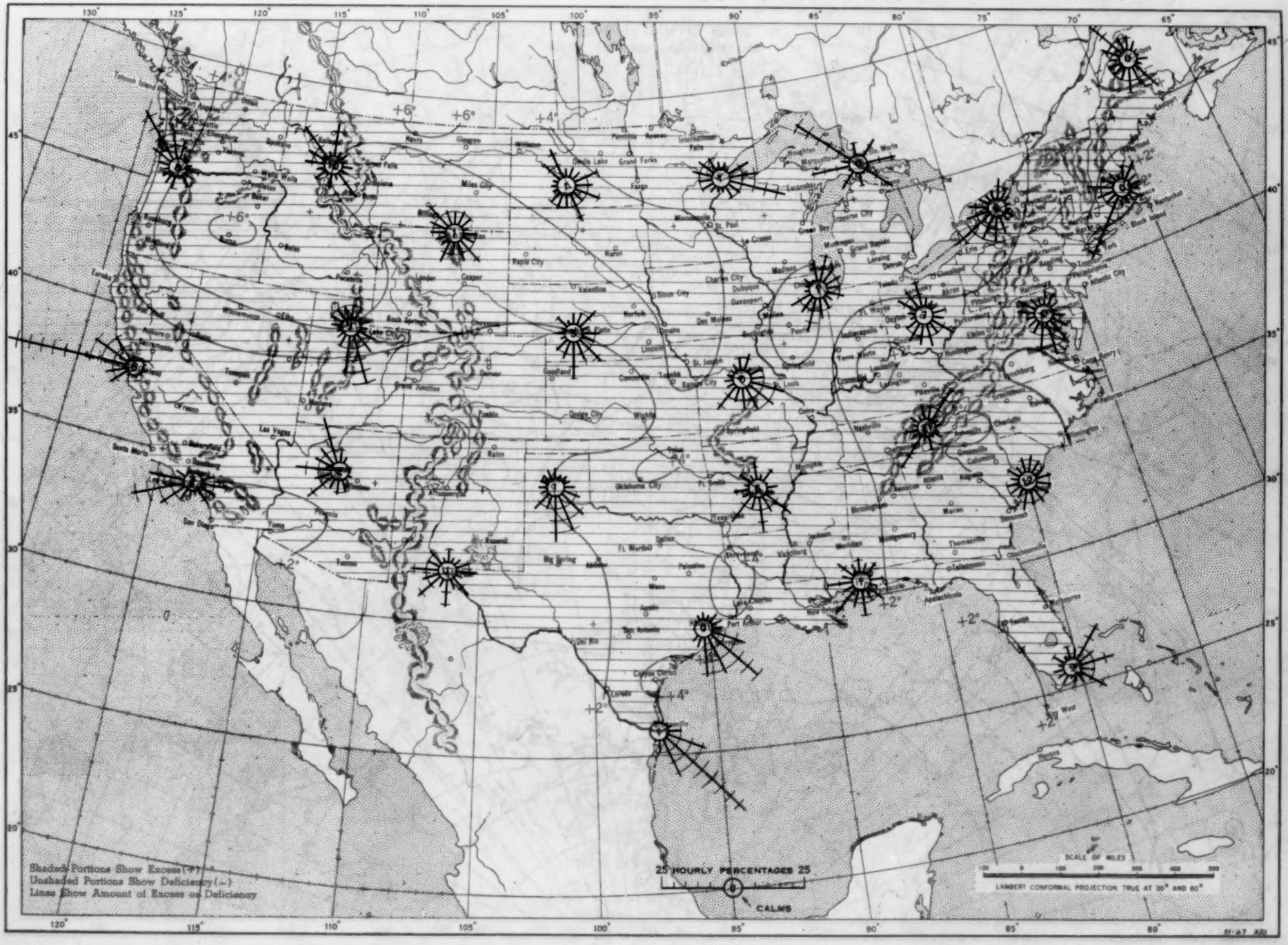
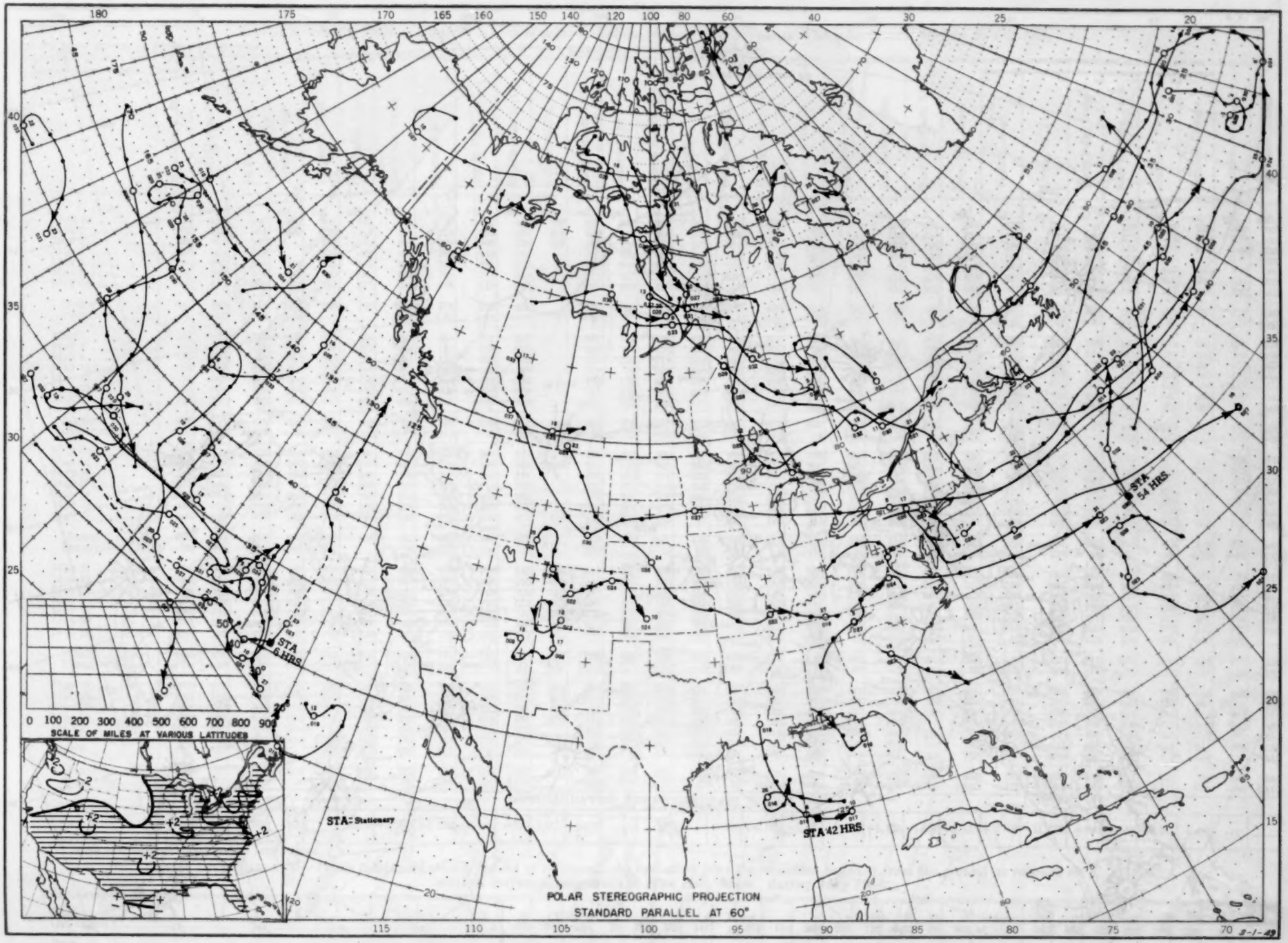

Shaded Portions Show Excess (+)
Unshaded Portions Show Deficiency (−)
Lines Show Amount of Excess or Deficiency
25 HOURLY PERCENTAGES 25
CALMS
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION TRUE AT 30° AND 60°

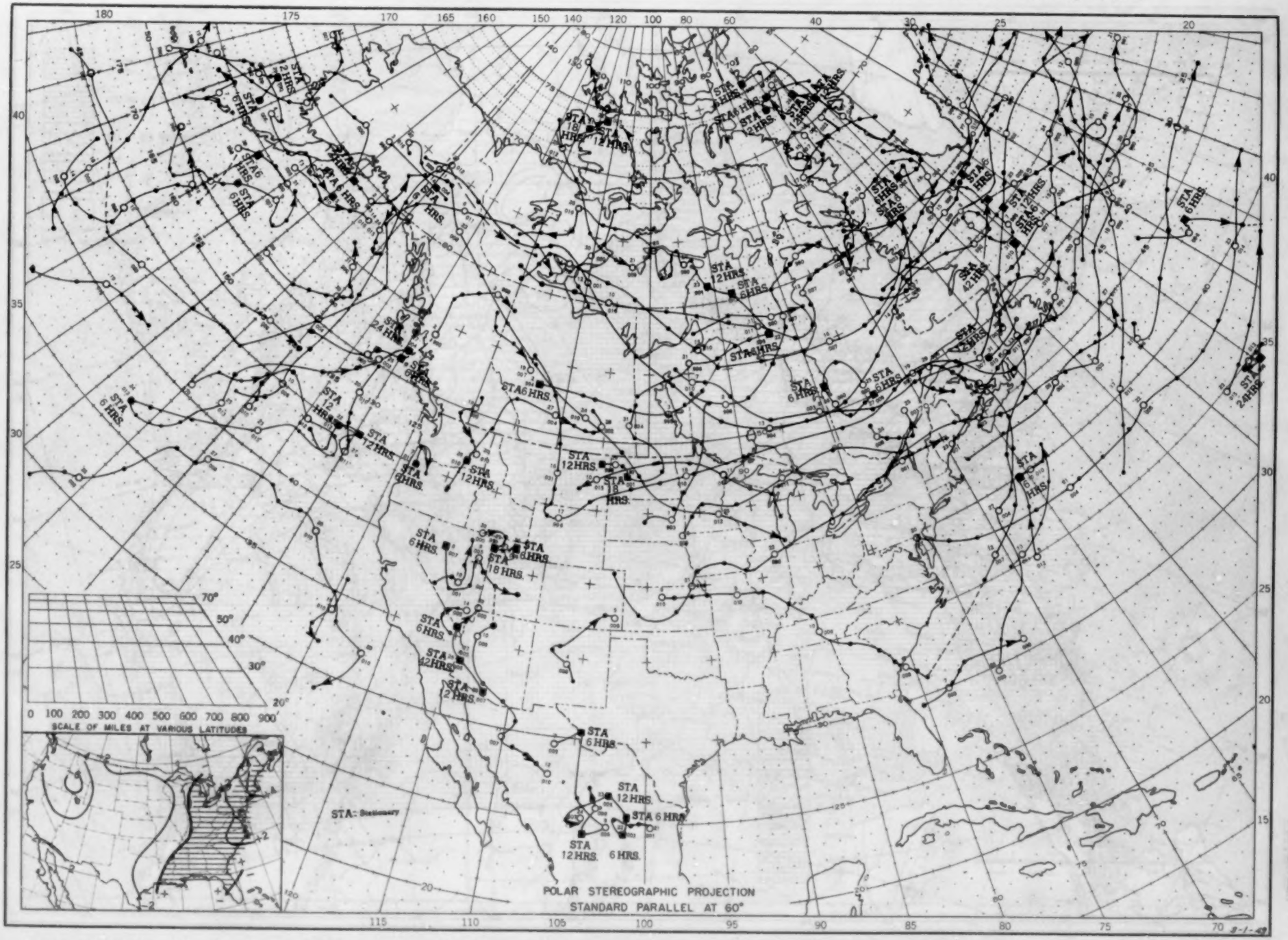
Chart II. Tracks of Centers of Anticyclones, May 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

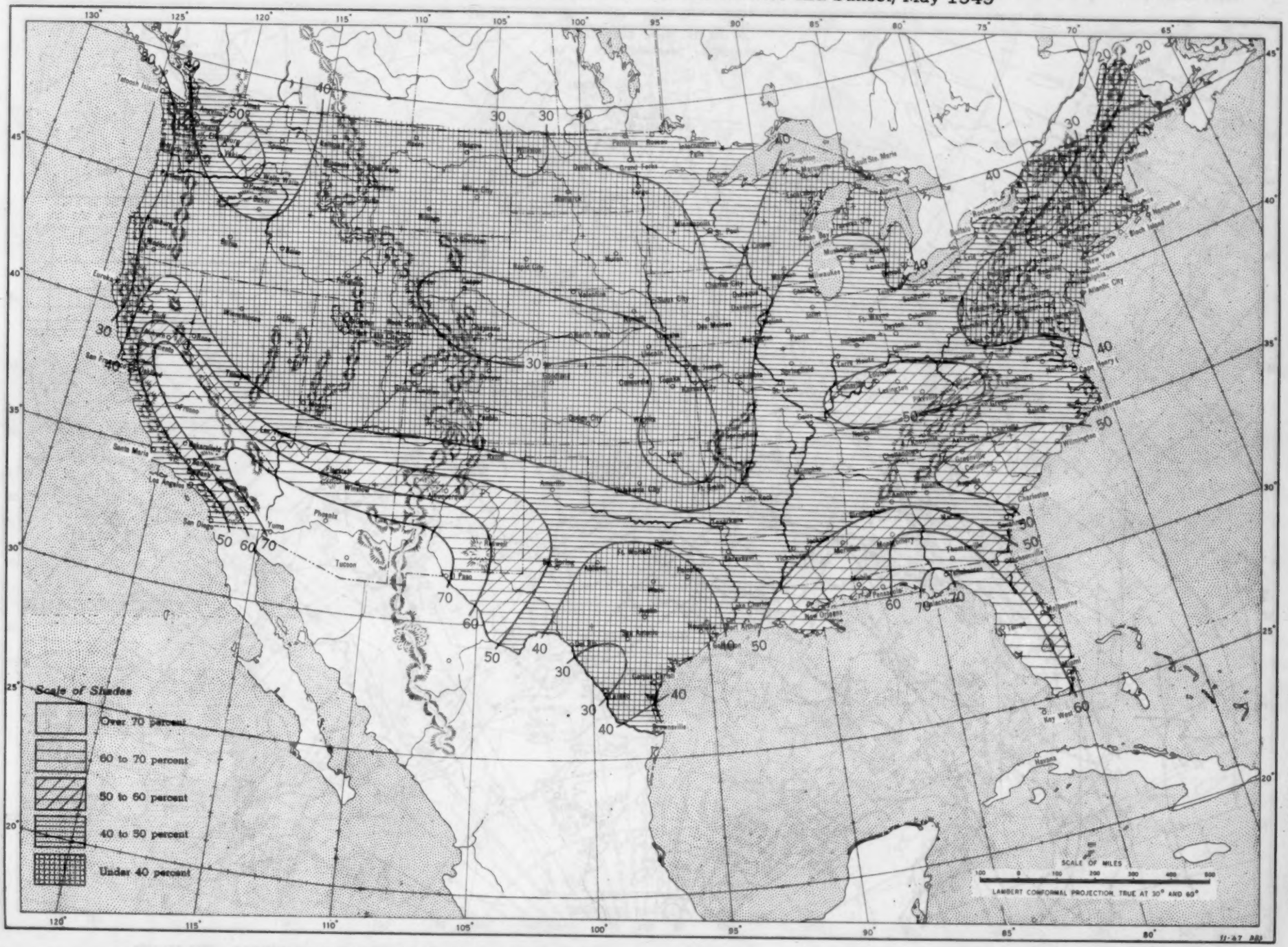
Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, May 1949. (Inset) Change in Mean Pressure from Preceding Month


STA: Stationary
SCALE OF MILES AT VARIOUS LATITUDES
0 100 200 300 400 500 600 700 800 900
POLAR STEREOGRAPHIC PROJECTION
STANDARD PARALLEL AT 60°

Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, May 1949


Scale of Shades
Over 70 percent
60 to 70 percent
50 to 60 percent
40 to 50 percent
Under 40 percent
SCALE OF MILES
LAMBERT CONFORMAL PROJECTION, TRUE AT 30° AND 60°

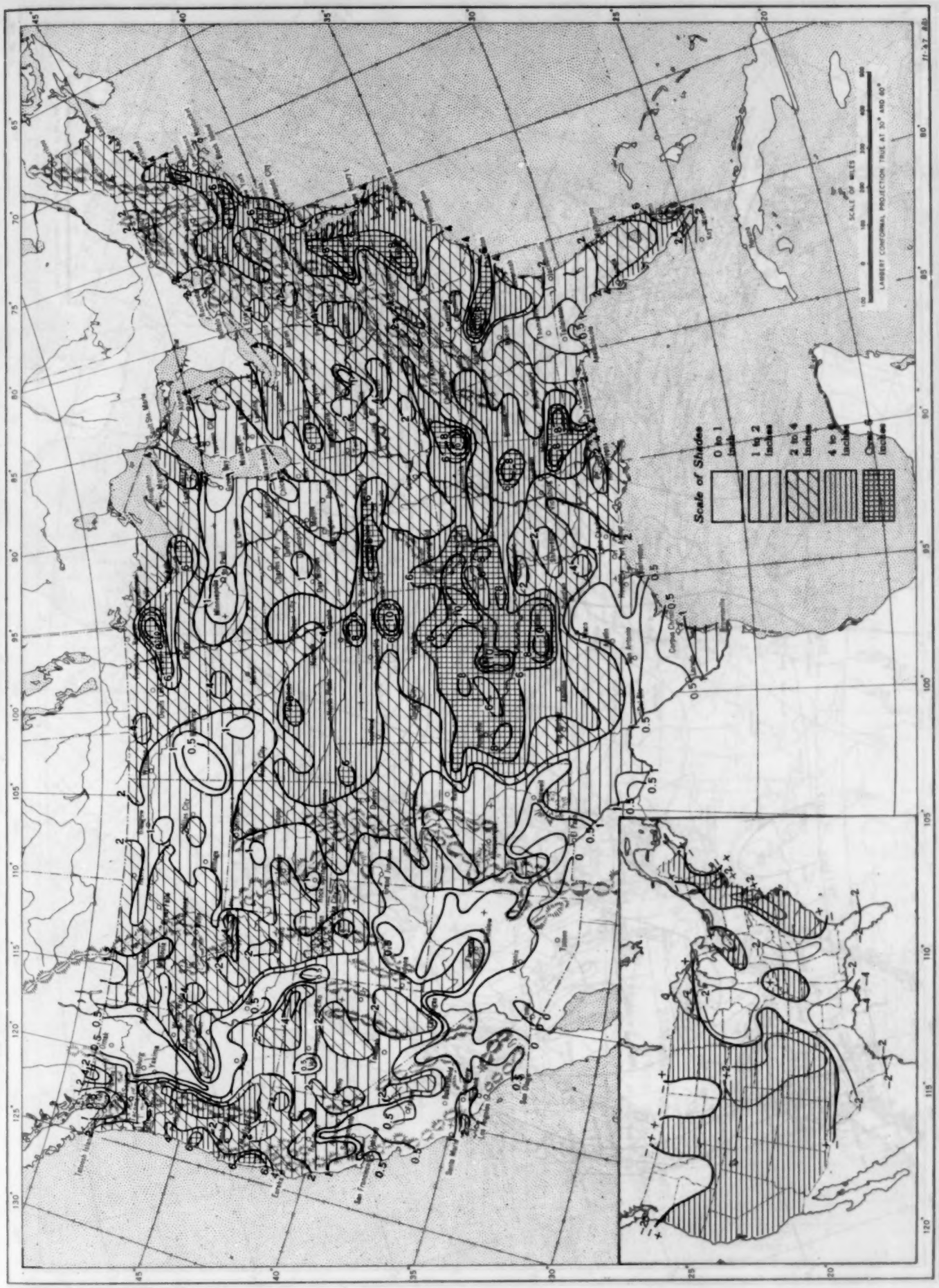

Scale of Shades
0 to 1 Inch
1 to 2 Inches
2 to 4 Inches
4 to 6 Inches
Over 6 Inches
LAMBERT CONFORMAL PROJECTION TRUE AT 30° AND 60°
SCALE OF MILES

Chart V. Total Precipitation, Inches, May 1949. (Inset) Departure of Precipitation from Normal

Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface, May 1949

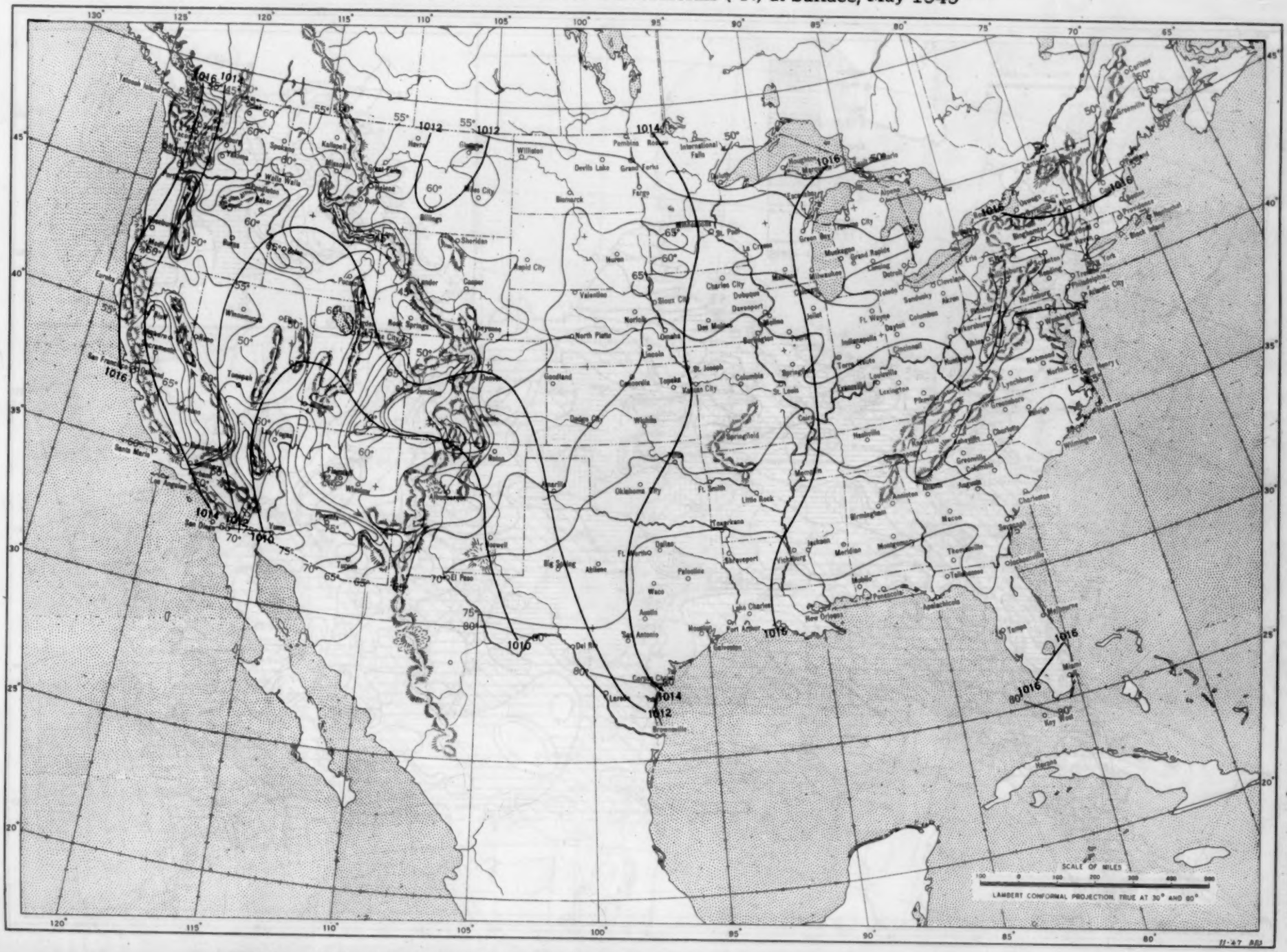
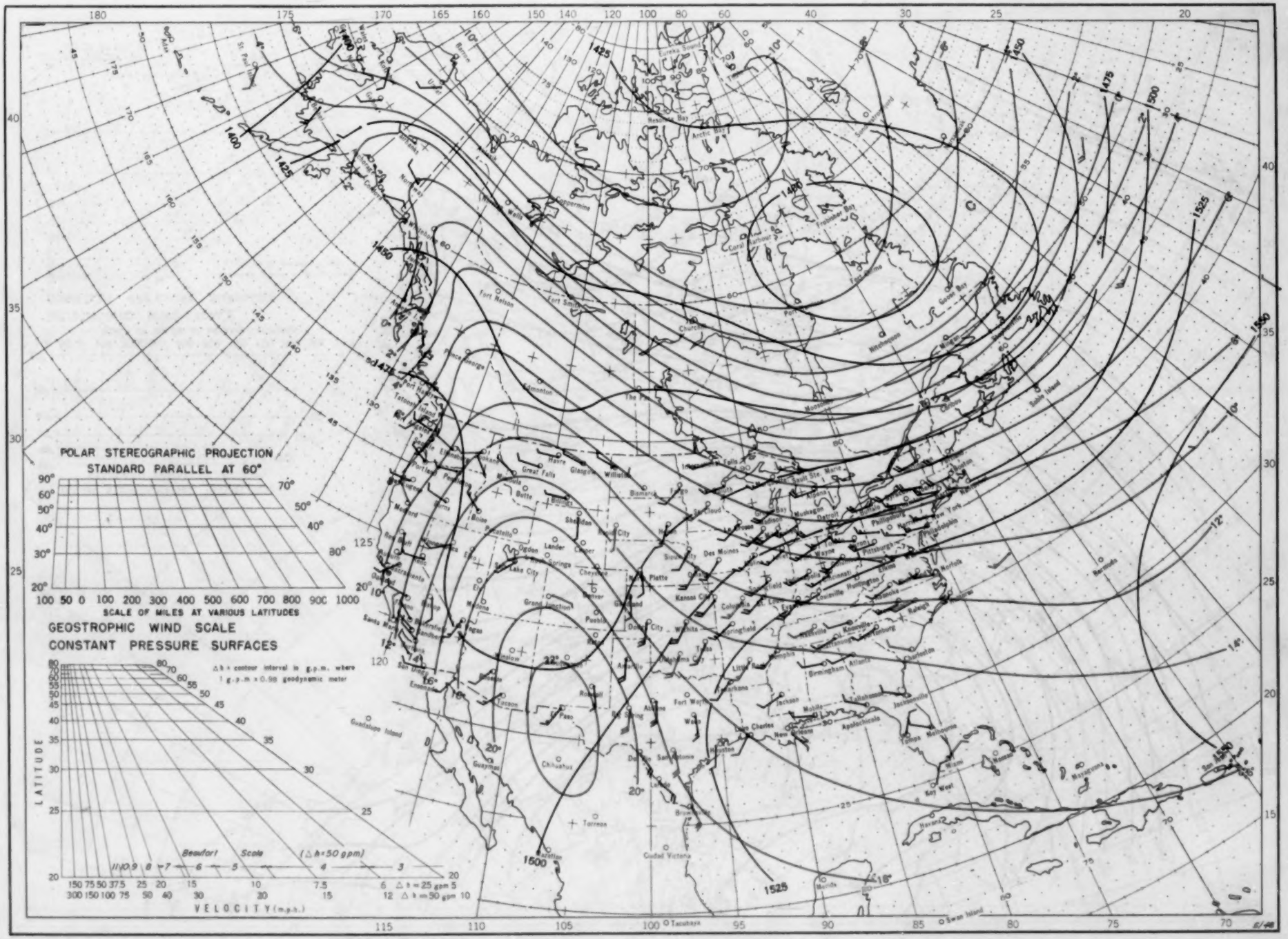


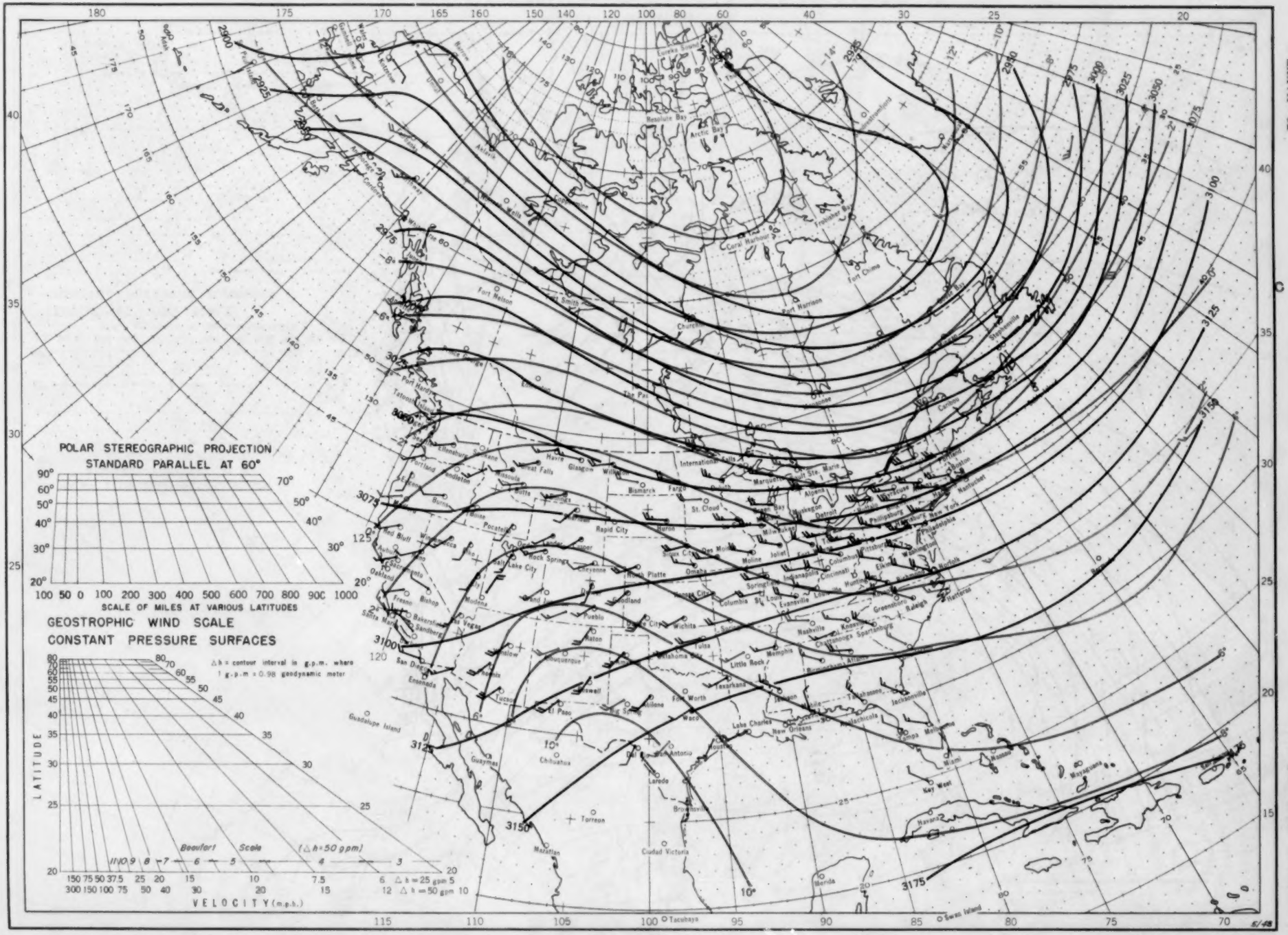
Chart VIII. May 1949. Contour Lines of Pressure in Height (Geopotential Meters) of Constant

Chart VIII, May 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

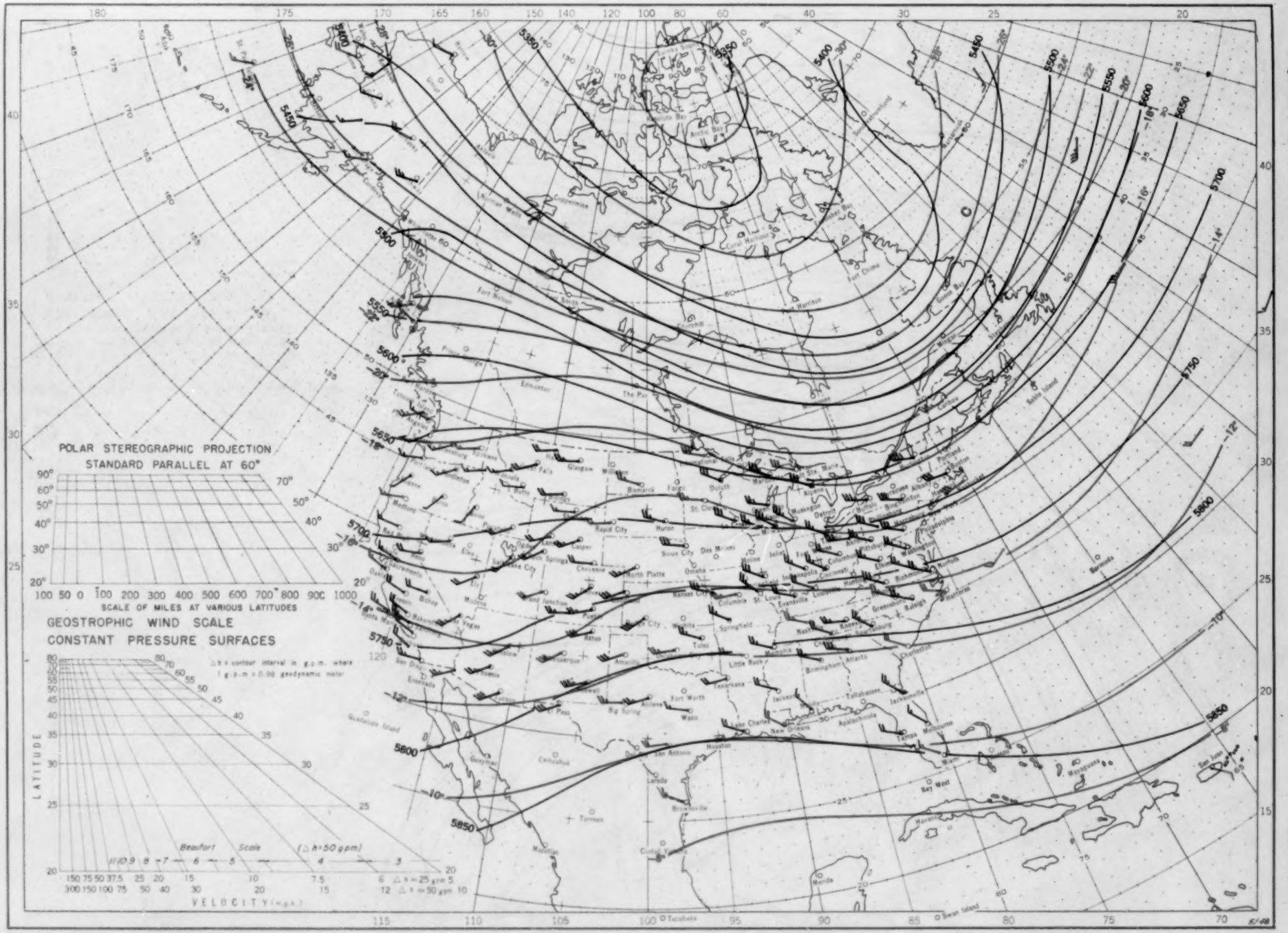
Chart IX, May 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

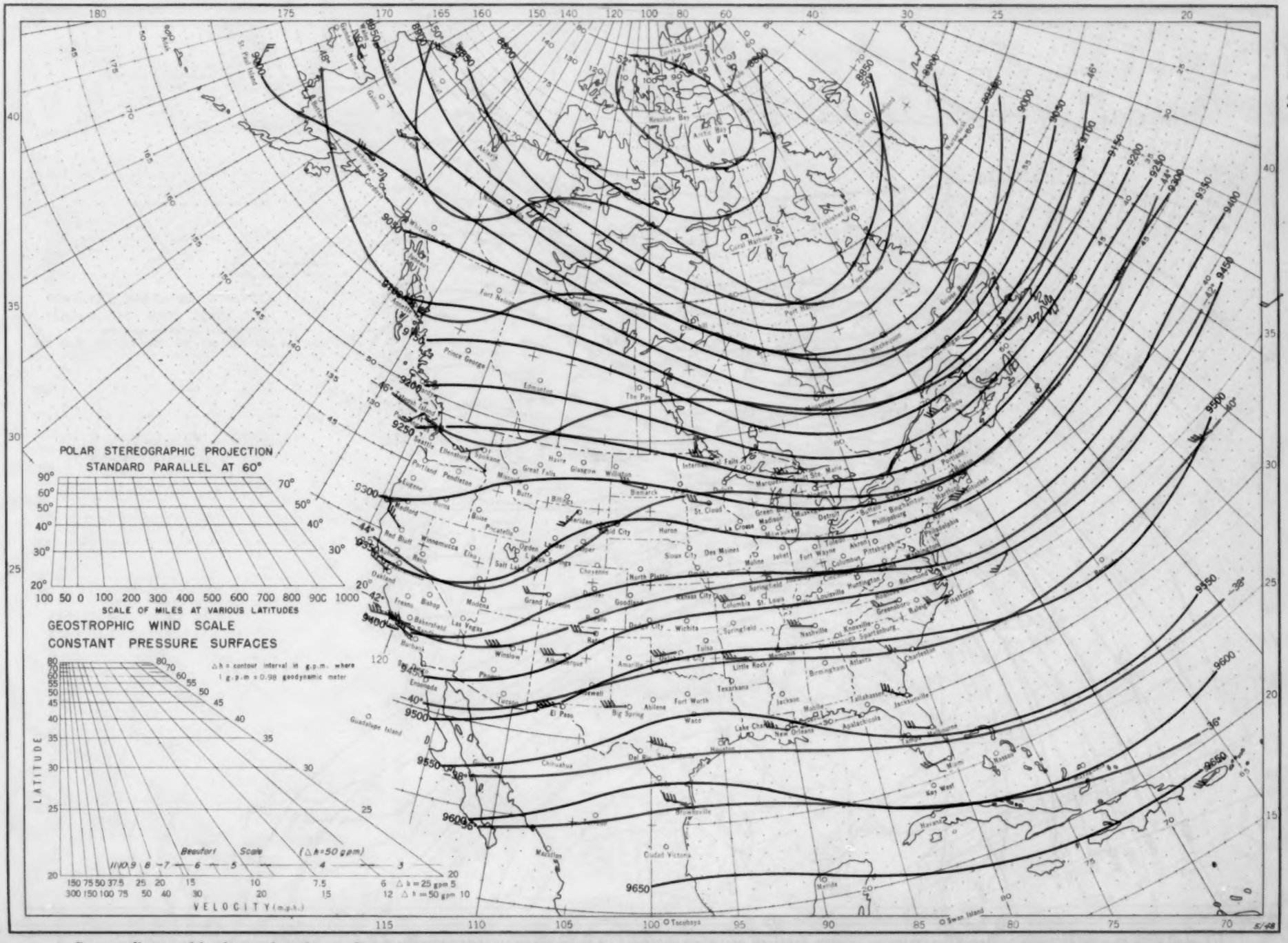
those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, May 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, May 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.